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57

Tanks

2374

**CARRIERS, MACHINE GUN, No. 1,
MARK I, AND No. 2, MARK I;
BREN, No. 1, MARK I AND No. 2,
MARKS I AND II;
CAVALRY, MARK I; AND SCOUT,
MARK I**

INSTRUCTION BOOK

1939

LONDON

Printed under the Authority of HIS MAJESTY'S STATIONERY OFFICE
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By Command of the Army Council,

H. J. Creed

THE WAR OFFICE,
15th February, 1939.

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FOREWORD

The instructions given in this manual have reference to the special features of the machine gun, Bren, cavalry and scout carriers, and will, if duly complied with, enable personnel of units equipped with these vehicles to maintain their vehicles in a state of mechanical efficiency, and wear will be reduced to a minimum.

In addition to the information contained herein, it is also necessary to have a thorough knowledge of the general principles of the construction and functioning of the components of mechanically propelled vehicles. The study of these general principles, as contained in the current edition of the Manual of Driving and Maintenance of Mechanically Propelled Vehicles (Wheeled), should therefore precede the study of special features of a particular type of vehicle.

Practical knowledge, combined with constant attention to all details of inspection and maintenance, prevents avoidable defects, whilst the effects of wear are minimized and can be anticipated and provided for.

Mechanical efficiency is further aided by the prompt replacement or repair of worn or defective components.

NOTE.—Machine gun carriers are those equipped with Vickers machine guns. These, and all vehicles of new manufacture, are to be equipped with Bren guns and Boys rifles, with consequent alterations to other equipment, and known as Carriers, Bren, No. 1, Mark I or No. 2, Marks I or II.

Carriers, M.G., No. 1, Mark I, of which 14 were made, are of mild steel. Six have been converted as pilot models for No. 2, Mark I, Cavalry and Scout carriers. The remaining 8 vehicles are regarded as instructional vehicles.

CHAPTER I

INTRODUCTION

Section I—General maintenance instructions

It is by inspection that the thoroughness of maintenance is checked and defects are discovered ; it is therefore essential that the functions embraced in the terms " inspection ", " maintenance " and " repairs " are clearly understood by all ranks.

These terms may be defined as :—

Inspection.—The process of inspecting and keeping under observation a vehicle and its components with a view to anticipating the development of defects, and the means whereby the efficiency of maintenance is checked.

Maintenance.—The process of adjusting components which, as the result of inspection, are noted as requiring attention, together with the regular lubrication and cleaning of the vehicle.

Repairs.—The process of repairing or replacing components which, as the result of inspection, have been noted as defective or have become damaged or broken while the vehicle is in use.

Inspections.—The value of all inspection lies in the prompt execution of all work noted as requiring attention.

Inspections are divided into categories :—

- (a) *Inspection by the crew.*
- (b) *Inspection by unit officers.*
- (c) *Technical inspection by O.M.Es.*
- (d) *Technical inspection by the C.I.A's. Department.*

(a) *Inspection by the crew.*—It is the duty of the crew to keep the vehicle under constant observation by regular inspections during maintenance, on the march and in the field. Furthermore, by noting carefully the performance and general running of the vehicle on all occasions, faults and wear, not otherwise apparent, will be detected.

(b) *Inspection by unit officers.*—It is the duty of commanders of sub-units to satisfy themselves periodically by personal inspection that their vehicles are being maintained in a thoroughly efficient condition, records of these inspections, together with faults noted and action taken to remedy them, being entered on the prescribed

forms. Unit commanders will take the necessary steps to ensure that inspection and maintenance are being carried out efficiently, that defects noted for attention are attended to without delay, and that all records required by regulations are properly kept.

(c) *Technical inspections by O.M.Es.*—These are carried out periodically, see current edition of Equipment Regulations, Part I, and are intended not only to enable the O.M.E. to note the state of serviceability of the vehicle, but to provide an opportunity for liaison between the “user” and the “repairer” organizations, to the benefit of both.

(d) *Technical inspections by C.I.A.'s. Department.*—These are carried out periodically under the orders of higher authority. It should be a point of honour with units that no defects are brought to light at these inspections which should have been previously detected by unit personnel.

Maintenance.—This consists of the daily attention to cleaning, lubrication and running adjustments necessary whenever the vehicles have been used, and the more extensive work of the same nature after the completion of certain mileages.

All maintenance is the duty of the crews under the supervision of unit officers, and the reliability, efficiency and life of mechanical vehicles are directly governed by the skill and methodical attention to detail with which this duty is carried out.

The efficiency of this maintenance is dependent on the organization within the unit, and each member of the crew must perform his share of the work. It is desirable to set aside at least one day a week for maintenance duties in addition to the normal daily attention which the vehicles receive.

After running, such duties as are necessary to ensure that vehicles are ready for immediate use will be automatically carried out, and the replenishment of fuel, oil and water will be carried out immediately on return to quarters.

Standard maintenance operations are the approved methods of replacing damaged or worn parts.

Repairs.—Repair of defects brought to light by breakdown or inspection, may be carried out by :—

The crew.—These are minor repairs and replacement of assemblies such as can be carried out with the tools available in the vehicle equipment.

Unit workshops.—These are “1st line repairs” and replacement of assemblies such as can be carried out by the technical staff of the unit with the tools available.

R.A.O.C. workshops.—These are “2nd line repairs” and will comprise all repairs and replacement for the carrying out of which the unit is not equipped.

On active service, circumstances may arise in which the crew and unit technical staff will be called upon to carry out repairs and replacement of assemblies which they would not normally be allowed to undertake. They can only be prepared for this by previous training in peace.

Section II.—Preparation for the road and driving

In preparing for the road a driver must :—

Ensure that he has—

Driving licence.

Standing orders for drivers i/c vehicles.

Accident report form A.F. A 3676, inner sheet “A”.

Transport work ticket, A.F. G 3518.

See that—

There is an ample supply of fuel in the main and reserve tanks.

The correct quantity of oil is in the engine and the lubricating system is working properly.

The water in the radiator is just below the baffle plate under the filler.

The driving lights are in order.

The registration number plates are not obscured.

Fire extinguishers are in position and fully charged.

The standard of driving in the service is high and drivers must remember that any lapse on their part will injure that reputation.

Road sense is essential to good driving and can be acquired by constant care and practice, even by those with little natural aptitude.

The chief qualities implied in the term “road sense” are—

Consideration and courtesy.

Power of making quick decisions.

Quickness of hand and eye.

Ability to judge distance.

Constant care and anticipation.

Knowledge of the following is essential to every driver and can be acquired from the Highway Code and from service manuals :—

The law relating to motor vehicles.

Signals used by drivers and traffic controllers.

Correct procedure in the event of accident or fire.

March discipline.

Crew drill.

The following are common faults, most fruitful of accidents—

Not keeping to the correct side of the road.

Overtaking without a visibly clear road.

Cutting in.

Violent braking.

Halting so as to form a dangerous obstruction, *e.g.* near a corner, hill crest or defile.

Cornering too fast.

Lack of caution at road junctions.

Action in the event of an accident—

The driver must—

Stop his vehicle at once.

Complete inner sheet "A" of A.F. A 3676.

Be careful that he makes no statement that might be taken to mean admission of liability for the accident.

Hand in inner sheet "A" immediately on return to barracks.

If no police officer was present at the accident, ensure that the accident is reported to the police within 24 hours of its occurrence.

CHAPTER II

POWER UNIT

Section I—Engine

Particulars.—Ford model SE-51E-6,000, or 79F, 6,000 CS eight cylinder, V-type, water cooled. Bore, 3.062 inch. Stroke, 3.75 inch. Cubic capacity, 3,621.5 c.c. Maximum B.H.P., 73 at 3,500 r.p.m. Treasury rating, 30 H.P. Maximum torque, 1,600-lb./inches at 1,500 r.p.m.

Cylinders.—A monoblock casting of eight cylinders, consisting of two blocks of four set at an angle of 90 degrees, extended to form crank case carrier with three main bearings. The firing order is 1, 5, 4, 8, 6, 3, 7, 2.

Valves.—The exhaust and inlet valves are of the overhead type, situated side by side, and are interchangeable. The valves are operated by push rods which also act as cam followers. The push rods are operated from the cams on the camshaft. There is no adjustment for wear.

Camshaft.—Is supported in three bearings and driven by helical gear from the crankshaft. The distributor and contact breaker are driven directly from the front end of the camshaft, thus eliminating the necessity for shafts, gears, etc., and adjustments to compensate for wear. The rear end of the camshaft drives the oil pump and operates the fuel pump push rod.

Crankshaft.—Is cast and has four crank pins each carrying two connecting rods on a common big end bush. The crankshaft is supported in three bearings.

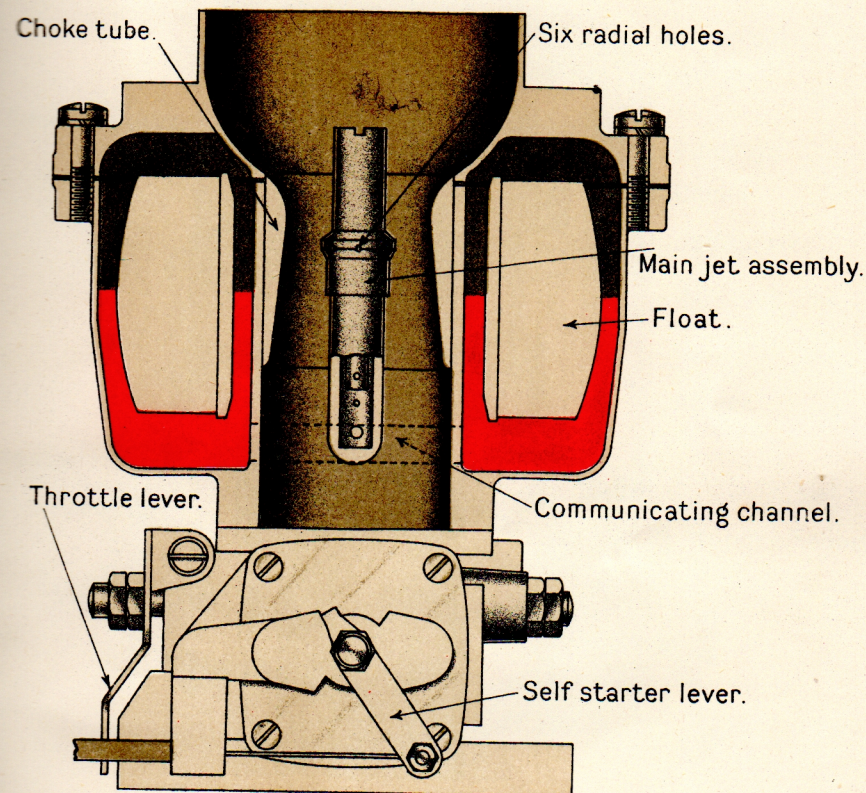


FIG. 1.

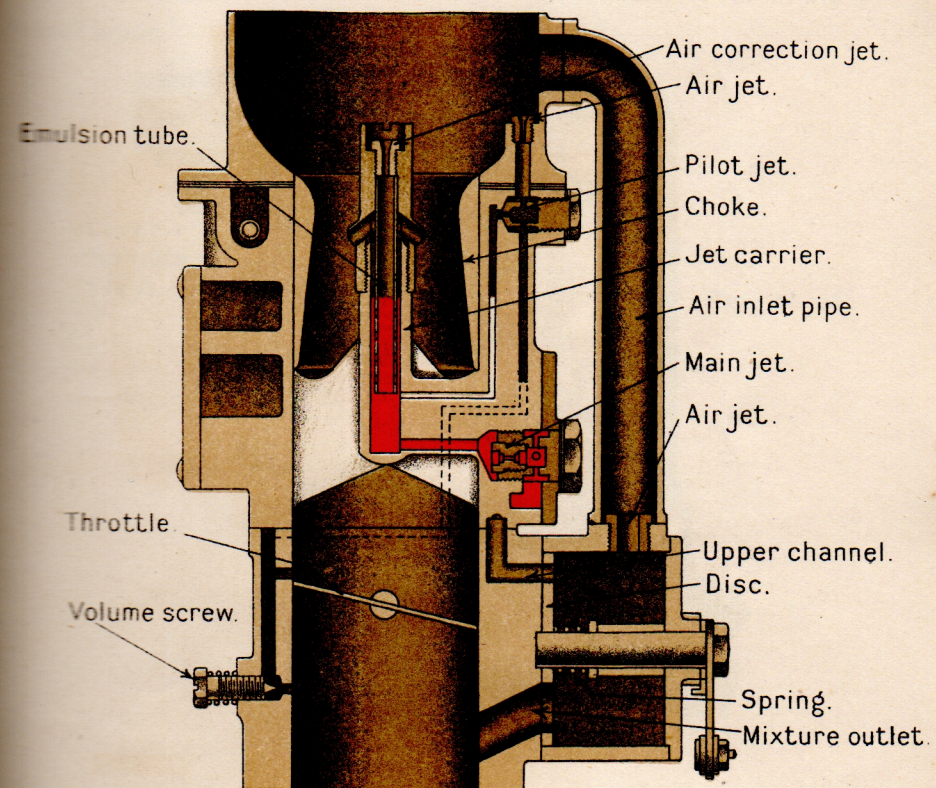


FIG. 2.

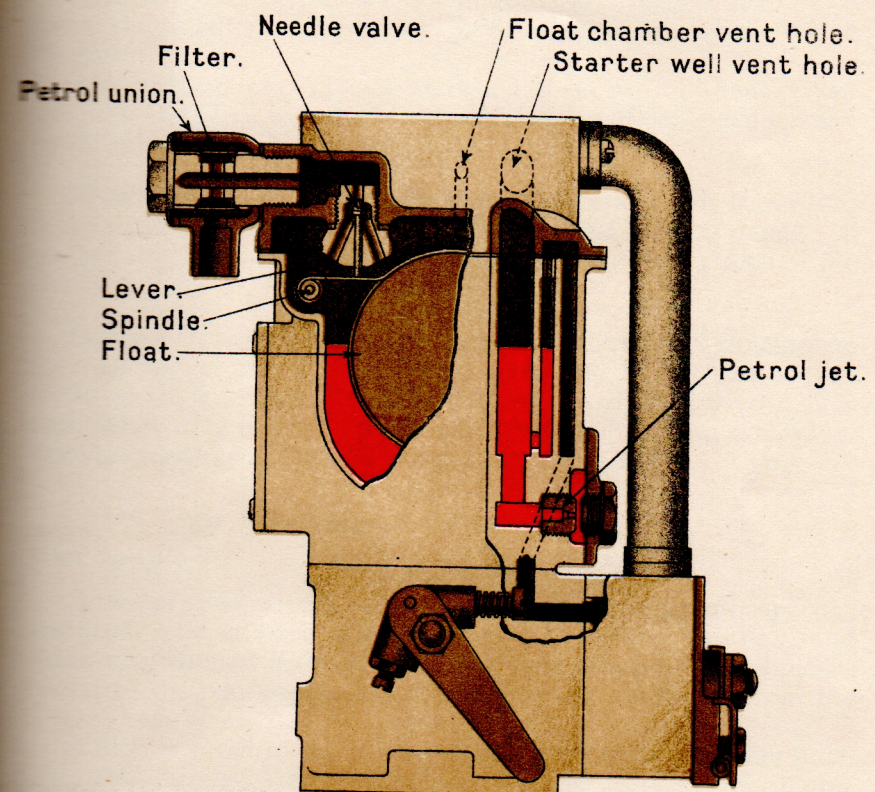


FIG 3.

Connecting rods.—Are steel forgings of H-section. The big end has a white-metal bearing in halves, each having four oil holes and a groove for pressure fed lubrication. The small end is bushed with white-metal.

Pistons.—Are of die-cast aluminium alloy construction. Two piston rings and one scraper ring are fitted in grooves at the top of the piston.

The gudgeon pins of case-hardened steel, are of tubular construction, and free to "float" in both the small end bearings and piston bosses.

Flywheel.—Is secured to the rear of the crankshaft flange and is prepared at its rear face to receive the engine clutch details; a toothed ring is fitted to its front edge to gear with the pinion of the starter motor.

Sump.—Is trough-shaped and formed at the rear end to complete the encasing of the flywheel when assembled to the upper part (cylinder block). It is provided with an oil dipstick carried in a tube fitted to a bracket on the near side, and a drain hole plug. The sump when correctly filled holds one gallon of oil.

Section II.—Fuel system

Fuel supply

Bren and scout carriers.—Two tanks, each of ten gallons capacity, are fitted, one on each side of the vehicle towards the rear, and either may be used through a two-way cock, mounted on a bracket bolted to the rear engine flange and remotely controlled from the driver's seat by an "Arens" control.

A filter is fitted to the suction pipe in each tank. A drain plug, accessible through a covered hole in the hull bottom plate is provided in each tank.

Cavalry carrier.—The fuel feed is similar to the foregoing, but there are four tanks: two main and two reserves. One main and one reserve tank is situated on each side of the vehicle and a two-way cock situated on the floor allows fuel to be drawn either from both main tanks or from both reserve tanks. The cock is similarly actuated by an "Arens" remote control.

Fuel pump.—This is mounted on top of the induction manifold. It is of the fabric diaphragm type and is operated by the push rod from an eccentric on the camshaft. The pump draws fuel from the tank and supplies it to the carburettor. No hand primer is fitted.

Carburettor, Solex, 40 Z.I.N.P. (Figs. 1, 2 and 3).—A non-spillable, dustproof carburettor of the downdraught type incor-

porating a starting unit controlled by a Bowden cable. It is of multi-jet construction giving a correct mixture for all engine speeds and loads.

The standard settings for the carburettor are :—

Jet size—

Main jet	160
Air bleed assembly 20	60 D.D. × 2 mm.
Speed jet	No. 70
Correction jet	240

Standard jet cap—

Needle valve	2.5
Choke	33

Starter setting—

Air jet (G.A.)	G.A. 6
Petrol jet (G.S.)	170

Throttle control.—Is operated by a foot pedal (accelerator) situated on the bottom plate of the vehicle in front of the driver.

NOTE.—There is no hand control for the throttle.

Air filter.—Is of the Vokes panel type, situated under the engine cover and connected to the carburettor intake by a tube.

Carburettor, Zenith, 42 V.E.I.—A carburettor of the down-draught pump type fitted with an automatic strangled flap interconnected with the throttle. It is of the multi-jet construction and provides a correct mixture at all throttle openings and engine speeds.

The standard settings for the carburettor are :—

Jet size—

Main jet	140
Economy	140
Compensating	120
Progression	180
Capacity tube	No. 2
Choke	31 mm.
Needle valve	2 mm.

Section III.—Ignition

Ignition system.—The ignition is obtained by a coil which is built together with a condenser, into the distributor unit.

Distributor and contact breaker.—The distributor is secured to the front cover of the crank case and is driven directly from the camshaft. The amount of advance is varied by a centrifugal governor and a vacuum brake. As the engine speeds up, the governor automatically advances the spark when accelerating, the sudden decrease in suction in the valve chamber cover is conveyed by

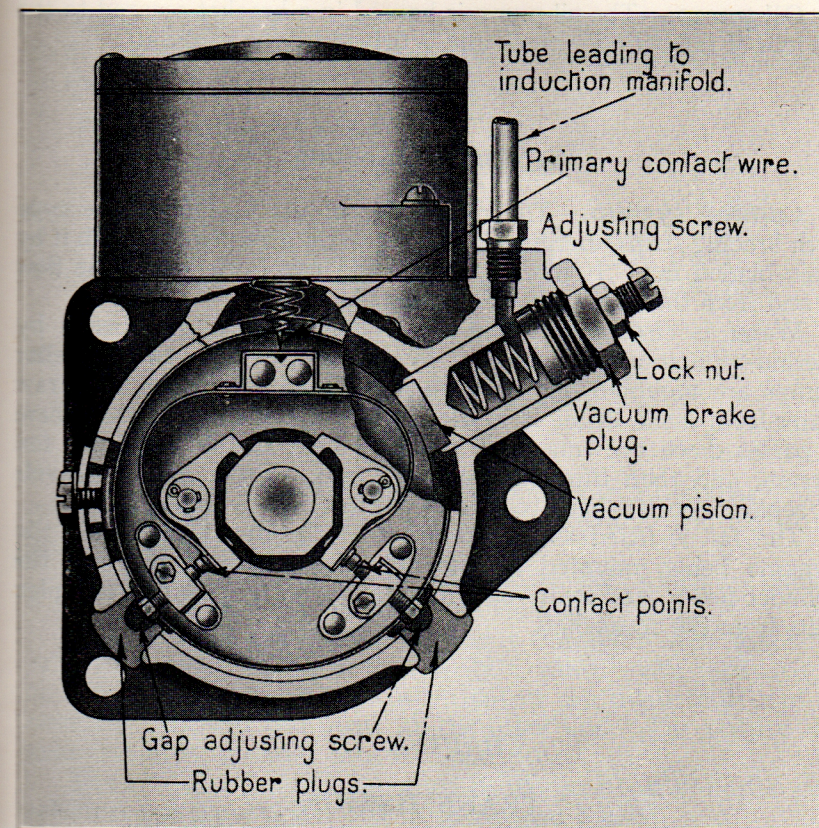


Fig. 4

a pipe to the distributor and allows a brake to be applied to the governor plate, thus retarding the spark during the period of acceleration.

The contact breaker is shown in Fig. 4.

Sparkling plugs.—The plugs for use with this engine are of the K.L.G. type K.1, but those supplied with the engine should be retained until unserviceable. The gaps should be set to 0.025 inch.

Section IV.—Engine lubrication

(Plate 1)

Lubrication system.—Lubrication is by pressure feed to the main and big end bearings by a geared pump driven from the camshaft. Normal working pressure is 30–40 lb. per square inch. The system is shown diagrammatically on Plate 1. The cylinder walls are lubricated by splash.

Oil pump.—The oil pump is housed in a bracket secured to the bottom of the cylinder block and is driven by the camshaft.

Section V.—Cooling

Cooling system.—The radiator is of the flattened tube type with bracing strips offering a large area to the air drawn through it by a six-bladed fan. It has two inlets and two outlets and the flow to and from the two banks of cylinders is distinct.

Water is circulated round the cylinder blocks and heads by thermo-syphon action assisted by impellers. The two impeller pumps are mounted one on each of the cylinder heads and draw water from them, lifting it to the header tank of the radiator, where it passes down the tubes and gives up heat to the air of the fan stream, and then through the lower tank. From here it travels by separate outlets back to each of the banks of cylinders.

The fan is fitted as an extension of the dynamo spindle, the dynamo being mounted on the induction manifold between the cylinder heads, and is driven with the two water pumps by duplex belts from the crankshaft.

CHAPTER III

TRANSMISSION

Section I.—Particulars

The transmission comprises engine clutch, gear-box, universal coupling and rear axle units.

Engine clutch.—The clutch is of the monoplate dry type with the clutch linings riveted to the spinner. Incorporated in the spinner is a damper consisting of eight springs which take up shock both when accelerating and decelerating. The three clutch release levers are mounted on needle roller bearings and fitted with weights on their outside extremities. The centrifugal force exerted by these weights, on speeding up the engine, pushes the levers forward and increases the clamping pressure on the friction faces. The clutch and flywheel are housed in an extension of the cylinder block.

Clutch control.—The clutch is operated by a foot lever mounted on the bottom plate of the vehicle in front of the driver.

Gear-box.—Is of the orthodox clash type and is rigidly bolted to the cylinder block.

Gear ratios.—Top speed is a direct drive from the clutch shaft to the main shaft while other speeds are transmitted from the layshaft to the main shaft by means of sliding gear.

The gear ratios are as follows :—

1st gear	..	..	..	..	..	6.4 to 1.
2nd gear	..	..	..	..	..	3.09 to 1.
3rd gear	..	..	..	..	..	1.69 to 1.
4th gear (direct drive)	..	..	..	..	..	1 to 1.
Reverse gear	..	..	..	..	..	7.82 to 1.

Section II.—Gear-box

(Plate 2)

The gear-box when bolted to the cylinder block forms part of the flywheel housing and encloses the clutch assembly and carries the gear change mechanism.

The clutch shaft teeth drive the layshaft gears which are made as a unit running on roller bearings on a stationary shaft.

The main shaft has a roller bearing in the clutch shaft, and at the other end a ball bearing in the gear-box casing. The combined top and 3rd gears slide at the clutch end of the main shaft and the combined 1st and 2nd gears at the other end. The reverse idler gear combination slides on a stationary shaft.

The reverse selector is mounted in the gear-box while the other selectors and the selector rods are in the gear-box lid.

Gear-box control.—Is operated by a small hand lever on the left of the driver. The normal gear change lever in the gear-box is shortened and connected to the hand lever by suitable jointed linkage.

Section III.—Gear-box lubrication

Lubrication is by splash and the gear-box when correctly filled holds $2\frac{1}{2}$ pints of oil.

Section IV.—Universal coupling

The drive of the engine is taken through the gear-box to the rear axle by means of a coupling (Fig. 5) consisting of a short cylindrical flanged housing which is spigoted to a bracket bolted to the end of the gear-box and bolted to the pinion housing of the rear axle differential casing and the rear plate of the vehicle.

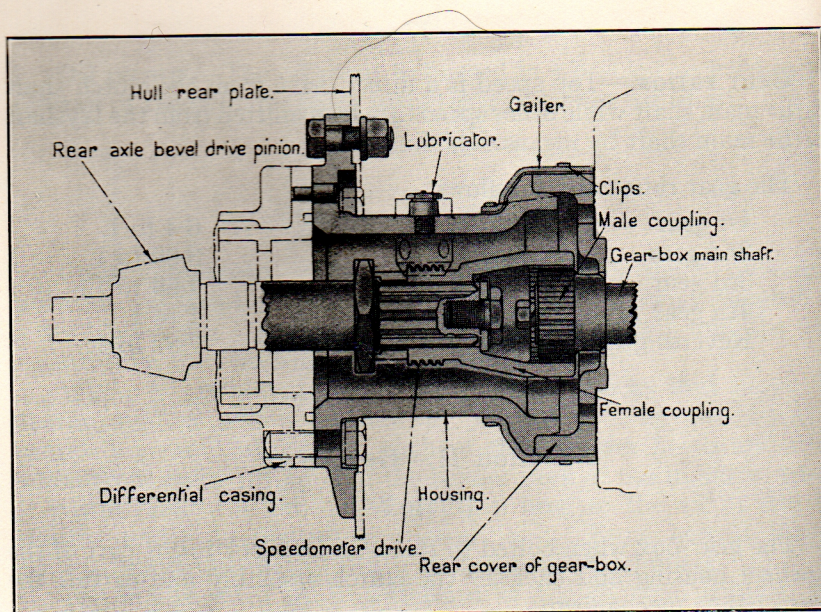


Fig. 5

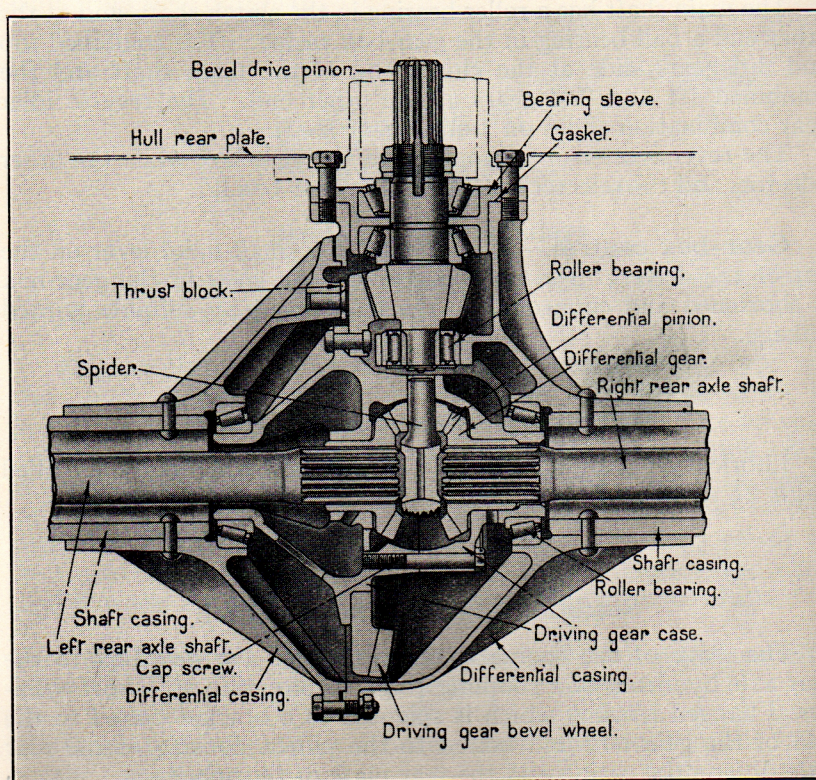


Fig. 6

Enclosed in the housing is a short shaft with an internal gear type universal or female coupling meshing with an externally toothed member or male coupling attached to the main shaft of the gear-box, and fitted to the bevel pinion shaft of the rear axle by means of an axial set screw, retaining plate and locking washer.

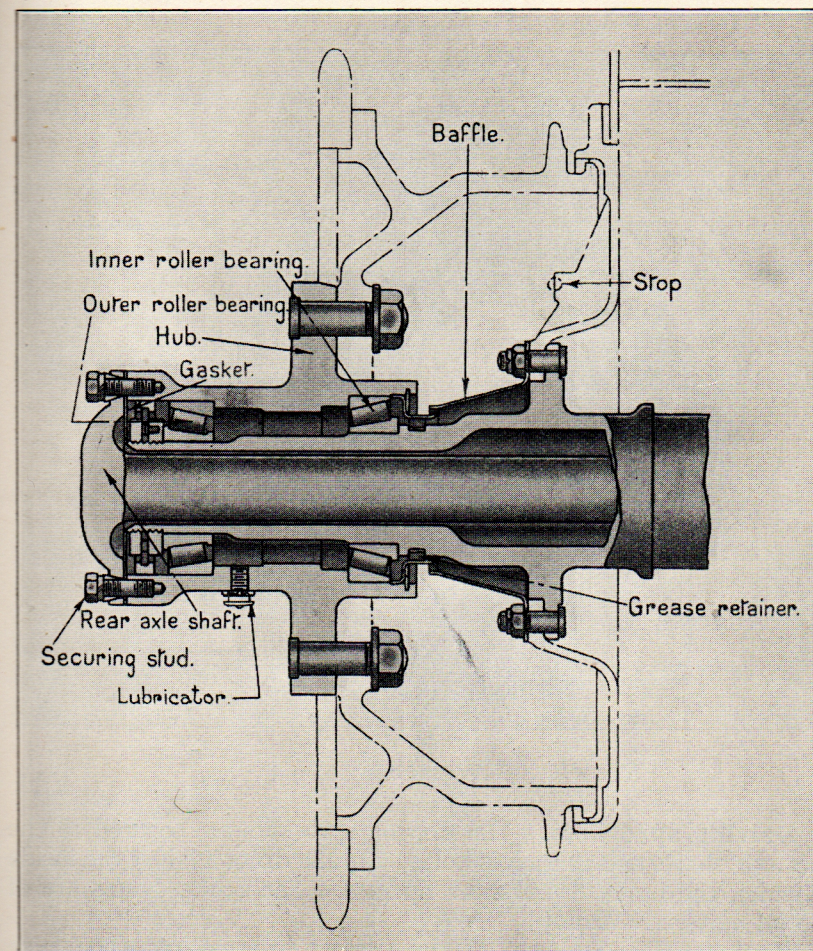


Fig. 7

A spiral gear is cut on the outside of the short shaft and this meshes with a gear on a small spindle located in the housing, to which the flexible shaft of the speedometer is connected. A lubricator is fitted to the top of the housing.

Section V.—Rear axle

Rear axle (Figs. 6 and 7).—The rear axle assembly is a Ford commercial vehicle type suitably modified to take track sprockets in lieu of wheels. The rear axle casing is bolted to the side and rear plates of the vehicle.

The bevel ratio is 5.83 to 1.

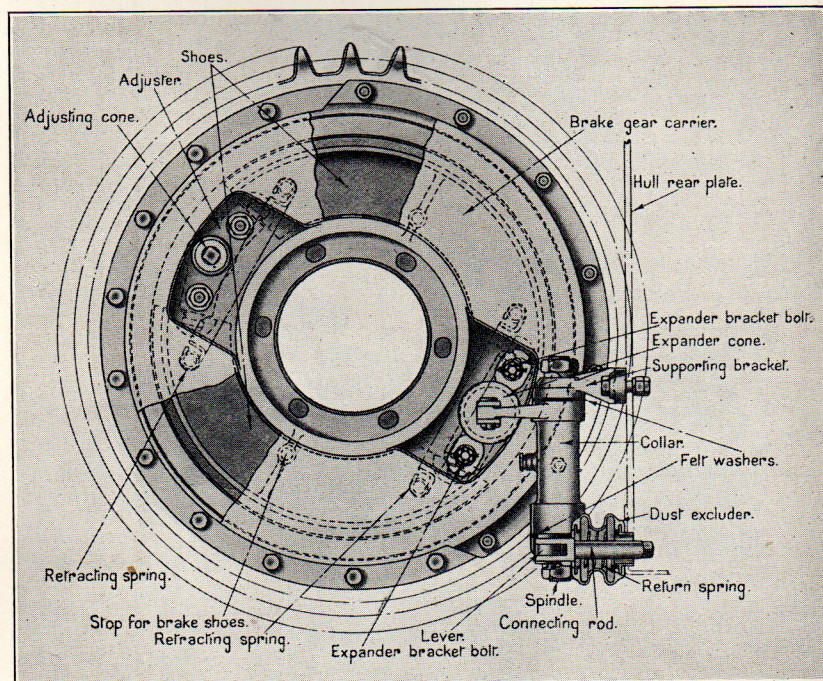


Fig. 8

Driving sprockets.—The driving sprockets are secured to the rear axle shafts and to each is bolted a brake drum against the inside of which the brake drum shoes operate. The brake drums are of special material (Walloy).

Brakes (Fig. 8).—Are of the Girling internal two-shoe type expanded by means of a hardened steel cone operating steel plungers bearing on the brake shoe ends. Hardened steel rollers are interposed between the cone and the plungers to reduce friction to a minimum.

The cone, rollers and shoe plungers are enclosed in a housing attached to the brake gear carrier which retains an adequate supply of lubricant. The other ends of the shoes are in contact with two short plungers working in a housing also attached to the brake gear

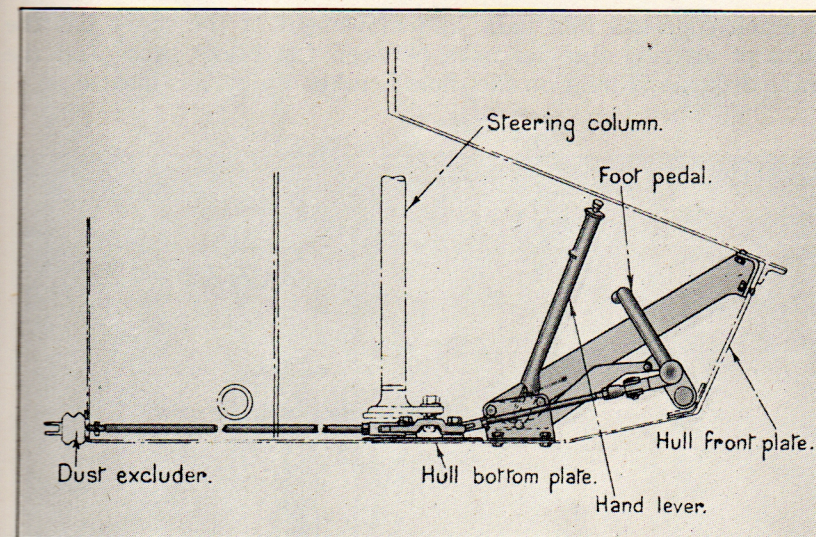


Fig. 9

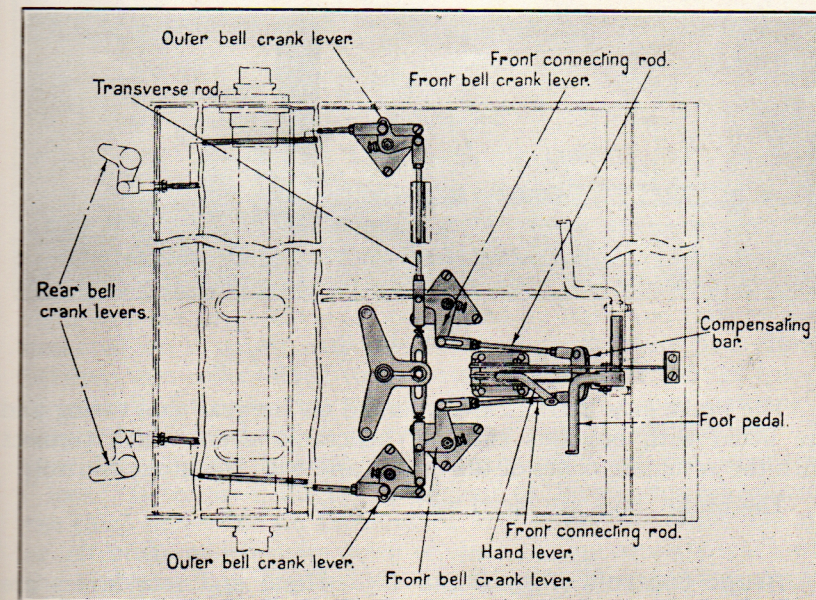


Fig. 10

carrier. These plungers are kept apart by the conical end of a screw.

Each cone has four flats, and movement of the screw has the effect of altering the clearance between the brake shoes and the brake drums and wear on the shoes is taken up by this means.

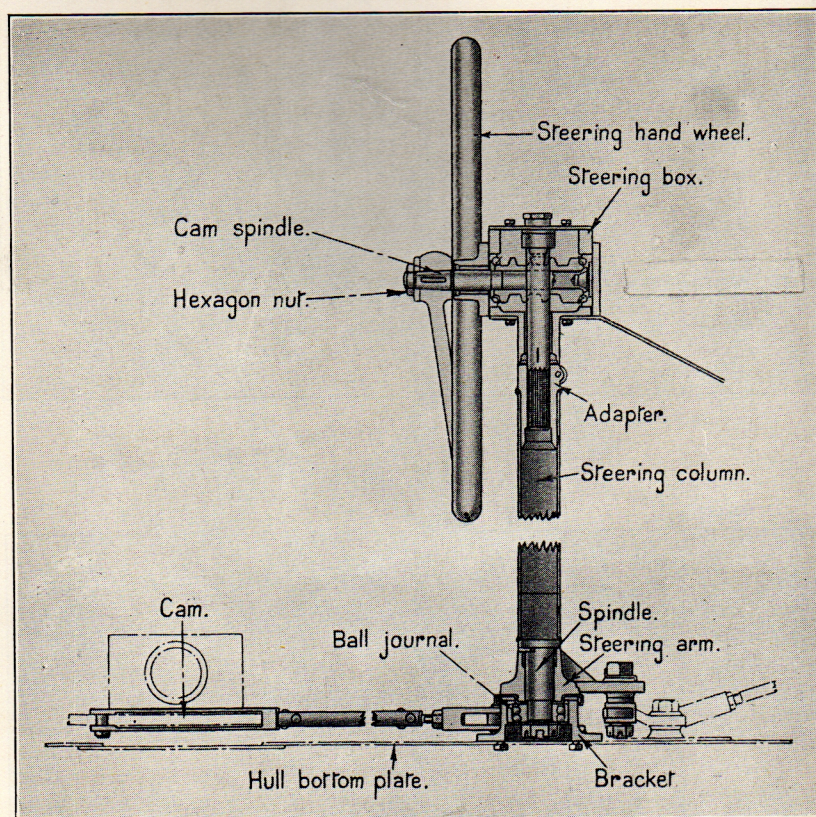


Fig. 11

The brake gear carriers are mounted on the rear axle casing and are fitted with brackets carrying bellcrank levers which connect with the actuating cones of the brakes and with the brake controls.

The brake shoes are faced with Ferodo.

Brake controls (Figs. 9 and 10).—Hand and foot levers are provided for operating the brakes when slowing up or stopping and the hand lever is provided with a ratchet quadrant and pawl to enable the vehicle to be left with the brakes on.

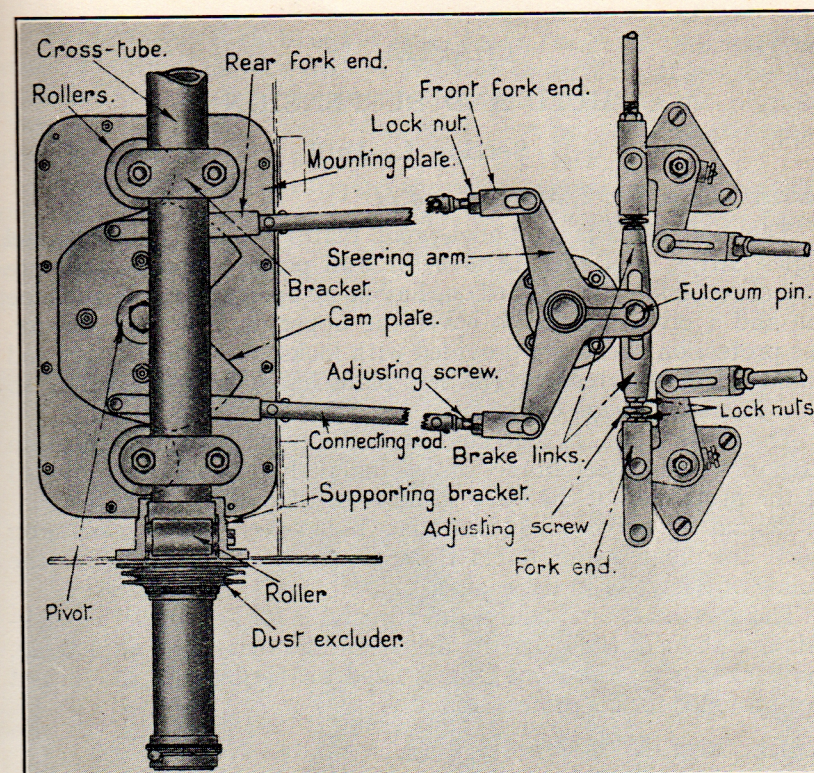


Fig. 12

Section VI.—Steering control

The vehicle is controlled by a steering wheel (Figs. 11 and 12) situated on the front plate immediately in front of the driver.

The wheel is geared to a vertical steering column at the bottom of which is mounted a steering arm having three projections. The right and left projections are connected by links and rods to a cam mounted on a spigot attached to the bottom plate and situated between two rollers fixed to the cross-tube. Movement of the cam by means of the steering wheel causes the cross-tube carrying the suspension front bogie to move to the right or to the left. This provides sufficient steering for ordinary purposes, but when more "lock" is required, further movement of the steering wheel causes the third projection on the steering arm to operate either the right or left brake which slows down or stops the appropriate track while the other track is speeded up through the differential gear of the rear axle.

CHAPTER IV

HULL AND SUSPENSION

Section I.—Hull

Carriers, Bren, No. 2, Marks I and II

The hull consists of bullet-proof plates riveted to mild steel angles, strips, tees, etc. Above the hull proper, in the front, are protection plates, the forward one having an aperture for the machine gun and a pivoted plate to cover the upper part of the aperture. The protection plates are provided with look-outs with shutters and laminated glass screens. The left plate has a hinged portion to allow increased vision to the left.

The engine, etc., is protected by bullet-proof plates mounted on a separate mild steel frame, and a double-hinged flap is provided for the protection of the third member of the crew.

Behind the driver and gunner is a bullet-proof division plate on which are mounted air ducts through which air is drawn for the cooling of the water in the engine.

The crew seats are padded and adjustable for height. The back-rests are padded, those for the driver and gunner being adjustable. The back-rest for the third man is fixed to the lower of the hinged flaps provided for his protection.

Carriers, Bren, No. 1, Mark I

The hull of these vehicles are of mild steel throughout and there is no back rest or rear flap for the third man.

Carriers, Scout, Mark I

The general construction of the hull, etc., is similar to Bren carriers, but provision is made for storage of a No. 11 wireless set, the batteries for which are stored in a bullet-proof box housed on the rear axle cover plate. The openings in the rear of the engine cover are covered with wire screens to eliminate interference with the wireless.

Carriers, Cavalry, Mark I

These vehicles differ in detail from Bren carriers and have seating accommodation for 6 men in addition to the driver and gunner. A hood is provided for their protection.

The engine cover is of modified design, having sliding access doors and a louvre at the rear.

Section II.—Suspension

The suspension is of the slow motion type with four bogie fork bracket assemblies; one front and one rear on each side of the vehicle.

Front bogie fork bracket (Fig. 13).—The main fork, carrying one bogie wheel, is mounted on and free to oscillate about the hull cross-tube, its bearings being provided with bushes for this purpose. Two cup-shaped lugs, lined with fabric, are prepared on the upper portion of the fork, one on either side of the track.

The secondary fork, carrying the other bogie wheel, is pivoted at one end to the main fork, by means of a pivot pin obliquely below the centre line of the cross-tube and is free to oscillate, being provided with bushes for this purpose. The opposite end of the fork is provided with two cup-shaped fabric-lined lugs. The pivot pin

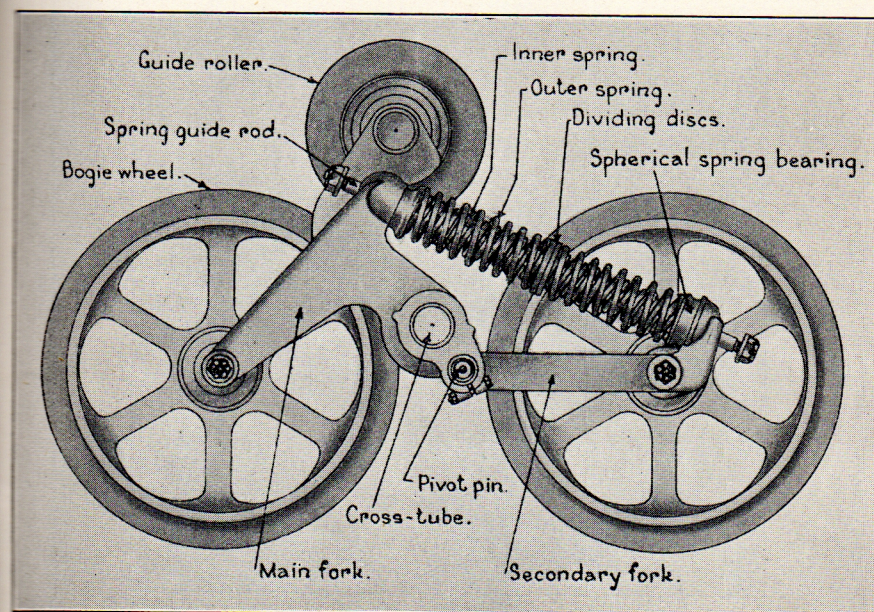


Fig. 13

is fitted with a fixed collar at one end and a loose collar on the opposite end to facilitate assembly. A groove is cut around the periphery of each collar to coincide with the clamping bolt holes of the main fork so that when the clamping bolts are tightened, the collars and pivot pin are held securely in position. Rubber sealing rings are fitted over the pivot pin and compressed tightly between the faces of the secondary fork and the collars, the faces of the fork and collars being suitably grooved to make an effective joint, preventing the egress of the lubricant and the ingress of dirt and grit. One end of the pivot pin is drilled and tapped to enable a set screw and washer to be used to facilitate compression of the sealing rings on assembly.

NOTE.—The pivot pin cannot be withdrawn by utilizing this tapped hole.

Two spring guide rods are fitted, one on each side, between the cup-shaped lugs of the main and secondary forks. Two spring dividing discs, two inner and two outer springs and two spherical spring bearings, pass through elongated holes in the lugs, thus allowing the spherical spring bearings to press against the fabric-lined cups of the forks by the action of the springs. Stop nuts are carried at each end of the rods.

The bogie wheels are fitted with rubber tyres and revolve on ball bearings.

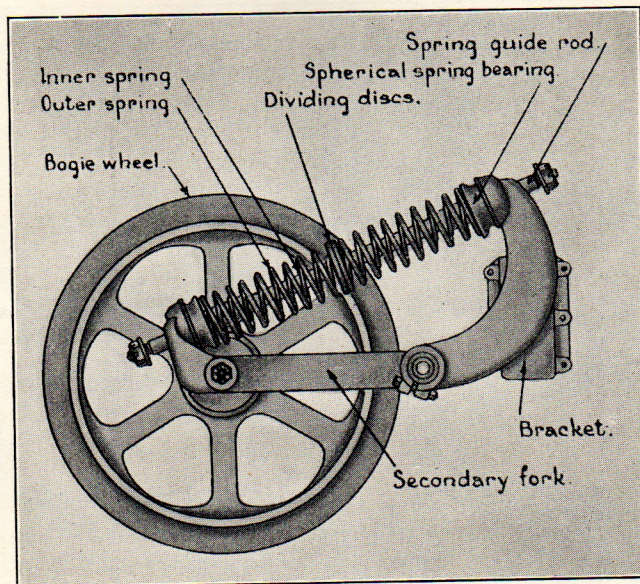


Fig. 14

Lugs are formed on the main fork, in which is mounted a spindle to take the guide roller.

The guide roller consists of a small wheel fitted with a rubber tyre and mounted on ball bearings.

Rear bogie fork bracket (Fig. 14).—The bracket is rigidly attached to the side plates and engine bearers of the vehicle and has two cup-shaped fabric-lined lugs. A secondary fork carrying a bogie wheel is pivoted to the bracket and spring guide rods and springs similar to those on the front bogies are fitted.

The bogie wheel is also similar to those on the front bogies.

Cross-tube.—Is used for steering and is free to move laterally in brackets bolted to the side plates (see Fig. 12). Square blocks

are welded to it and rollers, mounted on the brackets, engage with a hardened steel insert in the top face of each block.

Clamps on either side of the steering cam are mounted on the cross-tube and one bolt of each clamp serves as a pivot for roller bearings which are in contact with the cam faces. The actual mounting of the bearing is eccentric with respect to the axis of the bolt and this is used for obtaining correct setting of the rollers in relation to the cam.

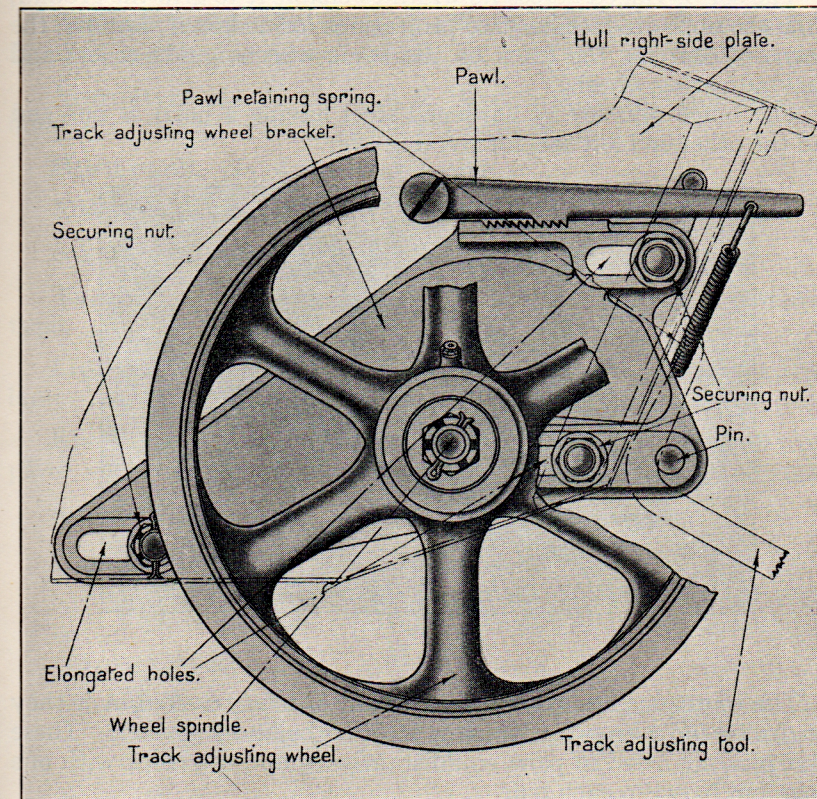


Fig. 15

Track adjusting wheels (Fig. 15).—These are similar to the bogie wheels in construction and are mounted, one on each side of the vehicle at the front, on track adjuster brackets, each of which is secured by three bolts to the hull side plate. The holes through which the bolts pass are elongated so that the bracket can be moved forward or backward to adjust the tension on the track. The top edge of each bracket is provided with teeth with which engages a spring-loaded pawl holding the bracket in position against the weight of the track while the securing nuts are being tightened up.

Tracks (Fig. 16).—Each vehicle is fitted with two 9½-inch tracks, one on either side of the hull, each consisting of 167 links, 161 hinge pins, 6 joint pins, 6 washers and 6 keep pins.

The links mesh with the driving sprocket wheel, which forms the means of propulsion.

The link is formed with two lugs and two gaps at the front and rear ends respectively. The lugs of one link fit into the gaps of the adjacent link, forming an endless chain.

The sole is ridged across its width to enable it to grip the ground, while the opposite face has two projections formed on it, forming the means of centring the track on the bogie wheels, guide rollers and track adjusting wheels.

The hinge pins are of hardened steel having a head at one end and the other end left soft for riveting over.

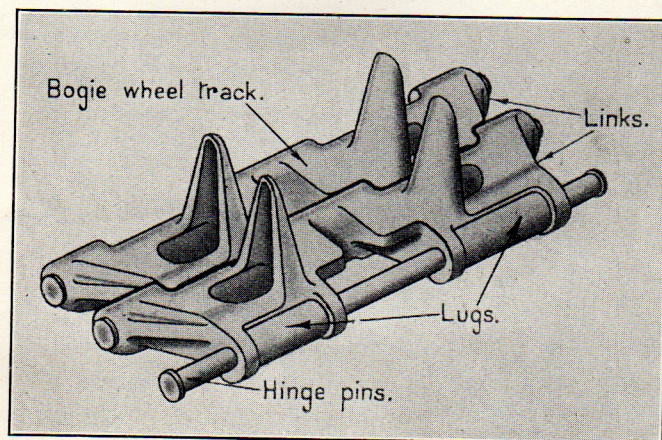


Fig. 16

The joint pins are similar but instead of being riveted over they are drilled for a keep pin which is inserted behind a washer. These joint pins are fitted in pairs equidistantly around the track with one hinge pin between each pair.

Tracks are designed to run dry and should never be lubricated.

CHAPTER V ELECTRICAL APPARATUS

(Plate 3)

Dynamo.—Is mounted over the induction manifold between the two cylinder heads and is driven by twin belts from the crankshaft and round the water pumps. The fan is fitted at the forward end of the dynamo spindle and is bolted to the driving pulley. The maximum charging rate is 15 amps.

Battery.—The battery is of the usual lead acid type and is rated at 6 volt 100 ampere-hour.

Starter motor.—Is of the 6-volt Ford type and is mounted on the off side of the engine.

Instrument board.—Is positioned on the right of the driver and mounts the festoon lamp, ammeter, oil pressure gauge, speedometer, horn push, fuse box, self-starter switch, tumbler light switches, switch box and inspection lamp adapter.

Festoon lamp.—Is of the C.A.V.-Bosch type and is used for illuminating the instrument board.

Ammeter.—Is of the C.A.V.-Bosch type and indicates the amount of charge or discharge of the battery.

Horn push.—Is of the Klaxet type.

Fuse box.—Is of the C.A.V.-Bosch type, No. 1.

Starter switch.—Is of the Lucas S2/0 push-in type.

Tumbler light switches.—Are of the Lundberg single-way type.

Lighting.—Two head lamps, which incorporate width indicating lamps, and two tail lamps, one red and one blue, are fitted.

Klaxet horn.—Is a short No. 10006 type bolted to the hull front plate, except in Cavalry carriers where it is bolted to the mudguard.

Suppression units

Bren, cavalry and scout carriers

Ignition leads—Spark plug ends 15,000 ohm resistors.

Coil—Filter unit (special)—2 chokes and 2 condensers.

Scout carriers

Ignition leads—Distributor end 5,000 ohm resistors.

Generator—Special filter unit—1 choke and 1 condenser.

Cut-out—1 condenser.

CHAPTER VI RUNNING INSTRUCTIONS

To start up.—Ascertain that the gear change lever is in the neutral position.

The engine, when cold, should always be started by hand.

(a) Turn on the fuel tap.

- (b) Pull out the starting control knob behind the driver to its fullest extent.
- (c) Turn the engine over several times by hand with the ignition switched off.
- (d) Switch on ignition leaving the starting control knob still pulled out.
- (e) Turn the engine by hand and it should fire after a few turns.
- (f) Push in the starting control knob as soon as possible without stopping the engine. Do not keep the control knob pulled out longer than is necessary.
- (g) Keep the engine running at a moderate speed until the oil warms up and circulates freely.

When starting after a short stop the engine is started by pressing the electric starter switch. The use of the starting control knob should not be necessary unless the engine fails to start readily.

Do not press the starter switch when the engine is running.

The engine should be allowed to warm through before moving off. **The starting unit should not be used except when necessary and its control must not be left in an intermediate position. It must be full out for starting and full in at other times.**

When the engine is stopped ascertain that the ignition is switched off as the distributor contacts may thereby become burnt and the battery unnecessarily discharged, making further starting difficult. If the engine has been driven hard and is very hot, it is advisable to allow it to cool while idling before switching off. The valves will be preserved by this practice.

Never drive with the foot on the clutch pedal as this may result in undue wear on the clutch facings and clutch withdrawal bearing.

Keep the engine speed low when engaging 1st gear on moving away from rest and at all times due regard should be paid to the engine speed when changing gear to avoid shock on the transmission. Care should be taken that at each movement, the gear change lever is moved as far as it will go.

Failure to start up.—Turn the engine over by hand and note whether the float chamber is full. Failure to deliver petrol may be due to:—

- (a) Empty fuel tank or fuel tap not turned on.
- (b) Dirty screen.
- (c) Leaky fuel line.
- (d) Punctured diaphragm. This is sometimes apparent by fuel leakage from the bottom chamber of the pump.

By short-circuiting the high tension wires see that the current is reaching the plugs; if not, suspect the coil and condenser. If the current is reaching the plugs take them out and lay them on the cylinder head and proceed as laid down in Chapter VII.

CHAPTER VII

MAINTENANCE

Section I.—General remarks

NOTE.—This chapter should be read in conjunction with the current edition of the Manual of Driving and Maintenance of Mechanically Propelled Vehicles (wheeled).

The standard of maintenance existing in any unit is dependent upon the skill and methodical attention with which this duty is performed and will clearly show itself in the running and general efficiency of the vehicle. It is therefore of the greatest importance that "Maintenance" and all that it implies, should be clearly defined.

Maintenance, which is the duty of the driver and unit technical staff, implies the efficient execution of the following operations:—

1. Regular lubrication and cleaning.
2. Adjustments including replacements.

Lubrication.—Implies the production of an oil film between two metal surfaces in contact, where otherwise wear would occur. Lubrication efficiency depends on:—

- (i) The use of the correct lubricant in the prescribed place.
- (ii) The application of such lubricant at the correct time, or after the prescribed mileage interval.

Guidance on both these points can be obtained direct from the lubrication chart on Plate 4 or from the wall chart issued for display in unit garages. The latter must be regarded as the most accurate guide as it is more likely to be up-to-date in the event of changes being made in the grades of lubricant, etc.

Adjustments including replacements.—Are standard operations which can be performed by the unit technical staff with the tools provided with the vehicle and not necessitating the removal of the vehicle to the R.A.O.C. workshops.

Section II.—Lubrication

(Plate 4)

Lubricants.—All oil used in the lubrication of service vehicles is issued in containers, the viscosity and nature of the oil being indicated by a number and prefix letter. Care should therefore be taken to ensure that such markings are not defaced, etc., as this would possibly lead to an issue of incorrect oil, resulting in probable damage to the vehicle due to inefficient lubrication. Unit oil stores should present a model of cleanliness and the greatest care should be exercised in decanting the oil from containers for issue.

Periodical inspection and lubrication.—The following operations should be executed in accordance with the instructions laid down on the vehicle lubrication chart.

Engine sump.—Requires one gallon of oil to fill it to the correct level. Before filling, the level of the oil should be checked by means of the dipstick whilst the vehicle is on level ground and brought up to the point marked FULL on the dipstick as found necessary.

NOTE.—It is advisable to keep the dipstick out when filling to provide an air vent and so promote rapid filling.

Distributor.—Fill the oil cup with engine oil and smear a light film of mineral jelly over the cam.

Engine clutch.—The clutch withdrawal shaft should be lubricated through the nipple at each end.

Gear-box.—The level should be checked periodically and should be filled to the top of the filling orifice.

Rear axle.—Remove the union of the breather pipe from the axle and pump in, through the lubricator at the bottom of the casing, sufficient oil until it overflows through the breather hole.

After the prescribed distance, the oil in the axle should be drained off by removing the plugs in the housing and the housing then flushed with paraffin. Fresh oil should then be added until it reaches the level of the breather hole.

Suspension.—The bogie wheels, guide rollers, front and rear bogie brackets and the track adjusting wheels should be oiled until the lubricant exudes as this will force out any mud or water that has entered.

The secondary fork bearings should be oiled until the lubricant exudes from the air relief valve.

NOTE.—The spherical spring bearings and fabric-lined cups should not be lubricated as best results are obtained if these are run dry.

Section III.—Cleaning

Drivers must be given sufficient time daily to clean and inspect their vehicles.

Suspension springs, rollers, etc., should always be washed down after a muddy journey thereby preserving the resilience of the suspension which is liable to excessive wear by the accumulation of mud or grit.

Do not oil or grease the tracks as they are designed to run dry.

During frosty weather, it is of special importance that the track and suspension should be thoroughly freed from mud on completion

of the day's run. Neglect to do so may result in the "freezing up" of the components and to attempt to run the vehicle in this state may lead to serious damage.

Immediately after the final technical inspection following a case of fire, all parts of the vehicle which have come in contact with the liquid as the result of the use of fire extinguishers, should be thoroughly cleaned without delay. Failure to observe this precaution may result in unnecessary damage by corrosion.

Section IV.—Adjustments including replacements

General remarks.—In order to maintain mechanical efficiency continuous attention must be given to adjustments which may be necessitated not only by mechanical defects but by the normal running of the vehicle. Even when operating under the best conditions, systematic adjustment of the moving parts will become necessary.

No attempt has been made to evolve a drill but the following adjustments and replacements will normally be carried out by the unit technical staff.

In emergency the drivers may have to undertake running adjustments, and in order to enable them to express whatever aptitude or ingenuity they may possess, they should be given facilities to assist the artificer personnel whenever possible.

The following are some of the more common causes which contribute towards breakdowns of vehicles :—

1. Non-observance of the rule of the road, particularly driving at excessive speed.
2. Overloading, especially on bad ground.
3. Failure on the part of drivers to bring to notice any defects which may have developed in their vehicles whilst out on duty.
4. Allowing grit and dirt to get into the fuel and lubricants.
5. Faulty gear changing and failure to make sufficient use of the wide range of gears provided.

Engine.—

Cylinder head nuts.—The cylinder head nuts should be checked for tightness after the first 150 miles, but thereafter will need no attention unless the cylinder heads have been removed.

Fuel system.—

Fuel tanks.—The tanks should occasionally be completely removed, washed out with petrol and replaced. This gets rid of all the sediment which may have collected in the tank.

Fuel pump.—Maintenance of the fuel pump will mostly be confined to draining the sediment chamber and cleaning the screen. To drain the sediment chamber first slack off the inlet union and then unscrew the drain screw which is immediately below. To clean the screen remove the screw from the top cover, remove the cover and lift out the screen and wash it in petrol.

On replacing see that the cover makes a correct joint on the cork sealing ring, that the two washers are retained on the screw correctly, *i.e.* the cork washer next to the cover, and that the joints of the inlet union and drain screw are tight.

Carburettor.—Being of the multi-jet type, this carburettor does not normally require adjustment. The only running adjustment necessary is to the idling speed and this is done by screwing in the volume screw on the throttle barrel to reduce the speed.

Air filter.—Should be removed periodically and the element removed and shaken free of all dust and dirt.

Ignition.—

Means of adjusting the timing to meet the requirements of the fuel used are provided by the vacuum brake adjusting screw.

Adjustment is obtained for the particular fuel used as follows :—

1. Loosen the adjusting screw lock nut and unscrew the adjusting screw until the engine “pinks” under the load. Turn the adjusting screw in, just enough to remove the “pink”, and tighten the lock nut to preserve the adjustment.

2. If trouble should be experienced which appears to be the result of faulty ignition, proceed as follows :—

(a) Disconnect the red wire from the coil.

(b) Turn the ignition switch to “on”.

(c) Lay the bared end of the disconnected wire on the cylinder.

If a spark does not occur, check each wire and connection back through the battery to the battery earth for a break in the circuit.

(d) If a spark does occur when the ignition switch to coil wire is “earthed” to the cylinder, remove the distributor side covers and examine the breaker points. If the points are worn, pitted or incorrectly spaced, dress them smooth with an oil stone. Adjust the gap to 0.014 to 0.016 inch with the fibre breaker arm on the high point of the cam and replace distributor side covers.

NOTE.—Badly burned breaker points are usually an indication of condenser trouble or a poor battery connection.

(e) If the trouble has not now been corrected, remove the distributor terminal plates and side covers and turn on the ignition. Earth a wooden-handled screwdriver to the distributor body, holding the end of the screwdriver blade about $\frac{3}{8}$ inch from the metal band around the centre of the rotor.

When the engine is cranked, a spark should occur between the rotor and the screwdriver. If a $\frac{3}{8}$ -inch spark occurs regularly, further tests of the primary circuit and the coil can be eliminated.

If a spark of less than $\frac{3}{8}$ inch only can be obtained, it is probable that the rotor, condenser or coil is short-circuited.

If no spark is seen, the primary circuit is not completed at some point within the distributor.

If a satisfactory spark is obtained at the rotor and no spark is noted at the plugs, the sparking plug wires, terminal plates or distributor side covers are short-circuited, probably due to the engine having been operated at some time with one of the sparking plug wires disconnected from either the plug or the terminal plate.

To isolate the part at fault while the engine is cranked, hold the plug end of each sparking plug wire $\frac{3}{8}$ inch away from the cylinder head. Wires producing this length of spark can be eliminated from further tests. Wires that do not meet this test should not be condemned until the distributor terminal plates and side covers are examined for evidence of leakage, and no such evidence is found.

On completion of this test the distributor terminal plates and side covers will be replaced.

(f) Check the gap between the sparking plug points, clean the plug and if necessary adjust the points to 0.025 inch. A faulty plug should be replaced.

Cooling system.—

Water pumps.—The water pumps need no adjustment but their securing bolts should be checked occasionally for tightness and the belts checked weekly for correct tension. The latter is correct when midway between the water pump and crankshaft pulleys and the total lateral movement of the belt does not exceed one inch. The adjustment is made by slackening the nut of the dynamo bracket stud and lifting the dynamo until the required belt tension is obtained.

NOTE.—The belts must not be too tight otherwise severe strain is put on the generator front bearing.

In frosty weather it is advisable to drain the water system at night; to do so, open the two drain cocks at the front end of the

cylinder block. Occasionally the water spaces should be flushed out with a hose until only clear water exudes.

Transmission.—

Engine clutch.—The only adjustment that is necessary is when there is not from $1\frac{1}{2}$ to 2 inches free movement of the foot pedal. This is accomplished by disconnecting the fork end and altering the length of the clutch control rod until this movement is obtained.

Brakes.—Adjustment for brake lining wear is obtained by rotation in a clockwise direction of the hardened steel cone, the brake lever being in the "off" position before commencing.

The brakes should be so adjusted that the drum can be rotated without the shoes binding.

NOTE.—The four flats on the cone face perform the following useful functions:—

- (a) The action of the brake shoe springs on the plungers serves to lock the cone in position when the adjustment is carried out.
- (b) The depth of the flats is such that they allow exactly the correct amount of shoe clearance in the drum when adjusted.

Suspension.—

Tracks.—Adjustment of the tracks to the correct tension is of importance. Excessive wear will result if too tight, while if too loose there is the risk of them detaching themselves when turning across country.

The ingress of mud or wet sand into the hinged joints of a track reduces its effective length and increases its tension. It is necessary, therefore, to consider the probable state of the ground over which the vehicle may operate and make allowances when adjusting "clean" tracks, *i.e.* the hinged joints of which are clean as a result of road running or after being washed with a high-pressure hose.

The ideal track tension is such that when all the slack is collected on the "top run" of the track, there is a sag of approximately $1\frac{1}{2}$ inches between the guide roller and the track adjusting wheel.

If the tracks are adjusted when "clean" before running in mud, they should be slackened until the amount of sag is approximately two inches to allow for the ingress of mud.

To adjust the track, loosen the two forward nuts which hold the bracket to the hull side plate. Insert the track adjusting tool between the hull rear plate and the bracket and pull up. This will draw the bracket back on the pawl, so tightening the track. Release the brake lever so allowing the driving sprocket wheel to turn and the tension of the track on either side of the sprocket to be equal.

If this is not done, all the slack may be in the part of the track between the first bogie wheel and the driving sprocket wheel, making it difficult to estimate the tension.

Balancing tracks.—Tracks are issued in pairs, *i.e.* they are of the same length, therefore the pitch of the links or distance between the pin centres is the same.

As the rate of wear in each track may be different, it is obvious that the pitch of one track may gradually become greater than that of the other. Should this be so the vehicle will no longer steer straight but gradually turn to the side of the short-pitched track.

To compare the pitch of two tracks the number of links in each track must be equal. Then, when stretched taut on the ground the longer track will be of longer pitch, a difference of one inch in total length being sufficient to cause faulty steering.

The track can be balanced by breaking into quarters and changing over alternate quarters, so that when joined up each track will be of equal length with the same number of links and in consequence of the same average pitch.

To remove a track, run the track so that a detachable pin is in front of the sprocket, slacken off the adjustment as necessary, remove the split pin and washer and drive out the pin by means of the track pin punch.

Electrical apparatus.—

Dynamo.—It should be seen occasionally that the brushes are free and the commutator clean. The latter can be done by wiping the commutator with a piece of clean rag dipped in petrol.

Battery.—The top of the battery should be kept clean and dry and the terminals tight and lightly covered with mineral jelly to prevent corrosion.

The electrolyte should be maintained at the correct level, *i.e.* $\frac{3}{8}$ inch above the top of the plates, by the addition of distilled water. Ascertain that the positive terminal is earthed.

Starter motor.—Requires no special attention beyond keeping the connections clean and tight and seeing that the commutator is clean and the brushes are renewed when necessary.

Klaxet horn.—It should not normally be necessary to adjust the note when once set, but if so desired, slacken off the lock nut of the adjusting lever, press the horn button and turn the adjusting lever until the motor can be heard rotating. Turn the adjusting lever in the opposite direction until a satisfactory note is obtained then tighten the lock nut.

APPENDIX I

POINTS TO BE OBSERVED DURING UNIT INSPECTION

NOTES.—(1) Pay particular attention to leakage of fuel, oil and water.

(2) Check all lubricators for serviceability and components for adequate lubrication. Use the lubrication chart as a guide.

(3) Check the tightness of nuts and bolts generally in addition to those specifically mentioned in the points to be inspected. Note that they are correctly wired or split pinned where necessary.

During special inspections, check the tightness of all nuts, bolts, etc., to which access can be obtained.

(4) Items marked "S" need only be inspected on "special inspections", or as a result of defects being suspected from the inspection of the rest of the vehicle.

INSPECTION ITEMS	INSPECTION DETAILS
ENGINE	
(1) Starter motor	Terminals. Brushes. Commutator. Bendix drive.
(2) Dynamo	Lubricator. Commutator. Brushes. Terminals. Cut-out.
(3) Cylinder heads and induction manifold	All nuts tight.
(4) Exhaust manifold	All nuts tight.
(5) Sump	All nuts tight. Leaks. Oil level.
(6) Water pumps	All nuts tight. Leaks.
(7) Engine supports	Secure. Rubber mountings serviceable.
(8) Silencers	Secure. Condition.
FAN AND COOLING SYSTEM	
(1) Fan belt	Tension (1 inch). Condition. Pulley bearings.
(2) Fan	Rivets tight. Nuts secure. Blades clear of radiator.
(3) Drain taps	Closed. Leaks.
(4) Radiator	Correct level. Clean externally. Hose and clips secure and serviceable. Filler tight.
(5) Radiator relief valve	Check for functioning.
(6) Oil cooler	Connections tight. Leaks. Relief. Valve setting. Fins on coil clean. Support brackets secure.
CARBURETTOR	
(1) Carburettor	Secure. No idle movement in controls. Starter control full travel. Fuel union filter clean.
(2) Air filter	Inspect elements.

FUEL SYSTEM

- (1) Fuel system Pump screws and unions tight. Filter gauze clean and cork washer intact. Fuel pipe secure and not damaged.

IGNITION SYSTEM

- (1) Coil and distributor Terminals secure. Cover secure and undamaged. Lubricator. Vacuum brake pipe secure and unbroken. Gaps 0.014 to 0.016 inch on contact breakers correct and clean.
- (2) Sparking plugs Gaps 0.025 inch correct and clean. Condition.

ELECTRICAL SYSTEM

- (1) Battery Terminals clean and tight. Electrolyte ("S" specific gravity according to type).
- (2) Fuse wires Correct gauge.
- (3) Leads Serviceable. Insulation. Frayed ends.
- (4) Lamps and horn Secure. Check working.
- (5) Switchboard Switches. Terminals. Ammeter readings.

ENGINE CLUTCH

- (1) Engine clutch Pedal movement. Lubrication.

TRANSMISSION COUPLINGS

- (1) Coupling Backlash. Lubrication. Speedometer drive.

GEAR-BOX

- (1) Gear-box Oil lever. Gear change lever engagement for all speeds. Leaks.

DIFFERENTIAL OR BEVEL

- (1) Rear axle All nuts and bolts tight. Leaks. Oil level. Backlash. General cleanliness "S". Play in sprocket bearings. Lubricators.

SUSPENSION

- (1) Suspension Cross-tube not bent. Free working in slides. Bogie wheels. Tyres for wear and cracks. Spring guide rods not bent. Stop nuts. Lubricators. Air relief valve. All nuts tight. Remove track and jack up. Test bogie wheel bearings and main fork bushes for wear.

SPROCKETS

- (1) Sprocket teeth Condition.

TRACK ADJUSTING WHEELS

- (1) Track adjusting wheel Nuts tight. Teeth and pawl. Tyre ("S" slacken track and test wheel bearings).

TRACKS

- (1) Tracks Pin heads secure. Joint pins secure. Washers and split pins perfect. Tension. Cracked links ("S" examine for cracks on inside of links).

HULL, BODY OR HOOD

- (1) Track guards Secure. Damage.
 (2) Access plates and covers .. Tight.
 (3) Hull Condition of paint ("S" cracks in plates and loose rivets).
 (4) Shutters Opening and closing.

INSTRUMENTS

- (1) Speedometer Cable. Condition. Lubrication.
 (2) Driving mirror Condition.

ROAD TEST

- (1) Start engine by hand—
 (a) Compression Note satisfactory.
 (b) Ease of starting Satisfactory. Starting handle condition.
 (c) Oil pressure 30-lb. per sq. inch at 2,600 r.p.m.
 (d) Exhaust Leaks.
 (e) Switch off Satisfactory.
 (2) Start engine by starter motor—
 (a) Starter motor Correct operation.
 (b) Electrical system Dynamo cuts in smoothly. Ammeter showing charge 3 to 15 amps.
 (c) Instrument board All instruments working. Glasses intact.
 (d) Water pump and cooling system Leaks.
 (e) Fuel system Leaks.
 (f) Engine lubricating system and cooler Leaks.
 (g) Slow running Even, if misfire, inspect plugs. Throttle stop. Check finally during road test when engine is warm.
 (h) Engine cover Secure. Catches and screws.
 (3) Drive vehicle on test run—
 (a) Clutch Satisfactory. Check for slip.
 (b) Test in all gears Satisfactory. Reverse catch. Play in gear change remote control.
 (c) Engine power Up to standard.
 (d) Speedometer Satisfactory.
 (e) Steering Correct operation.
 1st stage. Smoothness. No excessive play. No locking.
 2nd stage. Brakes. Linkages. Smoothness. Smooth change from right to left steering.
 Brakes. Note no binding in off position. Condition of brake shoes and linings. Test hand and foot brake operation.
 (f) Slow running Final check.

TOOLS AND EQUIPMENT

- (1) Pyrenes Brackets secure. Pyrene full.
 (2) Tools Correct and serviceable. Injector. Padlock and key.
 (3) Equipment Signal pistol case and other items—Secure. Condition.
 (4) Seats Cushion. Adjustment.

CLEANLINESS

- (1) Cleanliness Careful attention to detail.

ARMY BOOK 5

Complete and up-to-date. Note mileage since last change of oil. Experimental fittings.

Stowage of equipment, tools, spares, etc. and where carried on vehicle

Stores	Number carried	Carriers, M.G., No. 1, Mark I, Where carried	Carriers, Bren, No. 2, Mk. I and II, Where carried	Carriers, Cavalry, Mk. I, Where carried	Carriers, Scout, Mk. I, Where carried
Army book 5. Vehicle log sheet file	1	Not carried.	Back of driver's back rest.	Under front plate upper.	Under front plate upper.
Axes, pick, 4½-lb.—					
Heads... ..	1 (b)	—	On axle cover plate.	Front of kit bin.	On axle cover plate.
Helves	1 (b)	—			
Bars, jacking, No. 3, Mk. I	1	—	Left track guard.	Left track guard.	Left track guard.
Boxes, tin, empty, for 3 spare electric light bulbs	1	—	Tool locker.	Tool locker.	Tool locker.
Brushes, hand, bass, Mk. I	1	—	Right engine cover.	Left engine cover.	Right engine cover.
Bulbs, electric	3	—	In box tin empty.	In box tin empty.	In box tin empty.
Cans, lubricating, No. 11, Mk. I	1 (a)	—	Tool box.	Tool box.	Tool box.
Covers—					
Breech, Boys rifle	1	Not carried.	—	—	Left of gunners compartment.
Special, Bren	1	„	In container under front sloping plate.	In container under front sloping plate.	In container on left-hand engine cover side plate.
Waterproof, G.S., 20-ft. × 15-ft.	1 (c)	„	On left track guard.	Not carried (Hood).	On right track guard.
Crow bar	1	„	On rear axle vertical cover plate.	On rear axle vertical cover plate.	On rear axle vertical cover plate.
Extinguishers, fire—					
Brackets, pyrene type, broad back	3	—	2 on engine cover.	1 on kit locker.	1 inside armour on right of driver.
Tetrachloride type, filled	3	—	1 on left front protection plate.	1 right track guard.	1 outside armour on left of gunner.
Files—					
Bastard, hand, safe, safe edge, 8-in.	1	—	Tool box.	1 left front protection plate.	1 on top of engine cover left side.
Handles, medium	1	—			
Gauges, petrol	1	—	Left side plate inside.	Tool box.	Tool box.
Hammers, engineers, ball pane, 2-lb.	1	—	Tool box.	Left side plate inside.	Left side plate inside.
Holders, sparking plug, aluminium, screwed for 2 standard metric plugs	1	—	Tool box.	Tool box.	Tool box.
Injectors, lubricating, Tecalemit, No. 3A	2	—	„	„	„
Instruction book	1	—	With A.B.5.	With A.B.5.	With A.B.5.
Jacks, screw, lifting 4-tons, with handle	1	—	On left track guard.	On cam cover.	On axle cover plate.
Keys—					
Jet, for Zenith carburettor 42/VEI	1 (a)	Tool box.	Not carried.	Not carried.	Not carried.
Radiator drain plug.. .. .	1 (b)	Not carried.	Tool box.	Tool box.	Tool box.
Lamp, inspection, electric—					
Lucas, portable, S.B.C., No. 96	1	—	„	„	„
Padlocks, iron, galvanised, 1½-in.	2	—	On tool box and kit locker.	On tool box and kit locker.	On tool box and kit locker.
Pliers, side-cutting, 7-in.	1	Tool box.	Tool box.	Tool box.	Tool box.
Plugs, sparking, K.L.G. type K. I (18 mm. short reach)	2	—	In holder in tool box.	In holder in tool box.	In holder in tool box.
Protectors, muzzle	—	—	—	—	—
Punches, track hinge pin, Mk. III	1	—	Tool box.	Tool box.	Tool box.
Ropes, towing, steel, light	1	—	Axle cover plate.	Axle cover plate.	Axle cover plate.
Saws, folding	1	—	—	—	—
Screwdrivers, perfect, 9½-in.	1	—	Tool box.	Tool box.	Tool box.
Shovels, G.S.	1 (b)	—	Vertical axle cover plate.	Front of kit locker.	Vertical axle cover plate.
Sling for Bren gun	1	Not carried.	In container under front sloping plate.	In container under front sloping plate.	Left-hand engine cover side plate.
Spanners—					
Adjustable, 11-in.	1	Tool box.			
Adjusting, track	1	„			
Double ended ⅜-in. and ¼-in.	1	„			
Double ended for Zenith carburettor 42/VEI	1 (a)	„	Tool box.	Tool box.	Tool box.
Dynamo and fan adjusting	1	„			
Girling brake adjuster	1 (b)	—			
Single ended ⅝-in.	1	Tool box.			
½-in., ⅞-in., ⅝-in., and 1⅛-in.	1	„			
Tools—					
Adjusting track	1	—	Side of left mudguard.	Side of left mudguard.	Side of left mudguard.
Dismantling bogie springs, No. 4	1	Tool box.	Tool box.	Tool box.	Tool box.
Wedges—					
No. 1	1	Tool box.	Tool box.	Tool box.	Tool box.
No. 2	1	„			
No. 3	1	„			
Wrenches—					
⅞-in. × ½-in.	1	Tool box.	Tool box.	Tool box.	Tool box.
⅞-in. × ⅝-in.	1	„			
Sparking plug and cylinder head nut	1	„			

(a) For Carriers having Zenith carburettors only.

(b) Not for Carrier, M.G., No. 1, Mark.

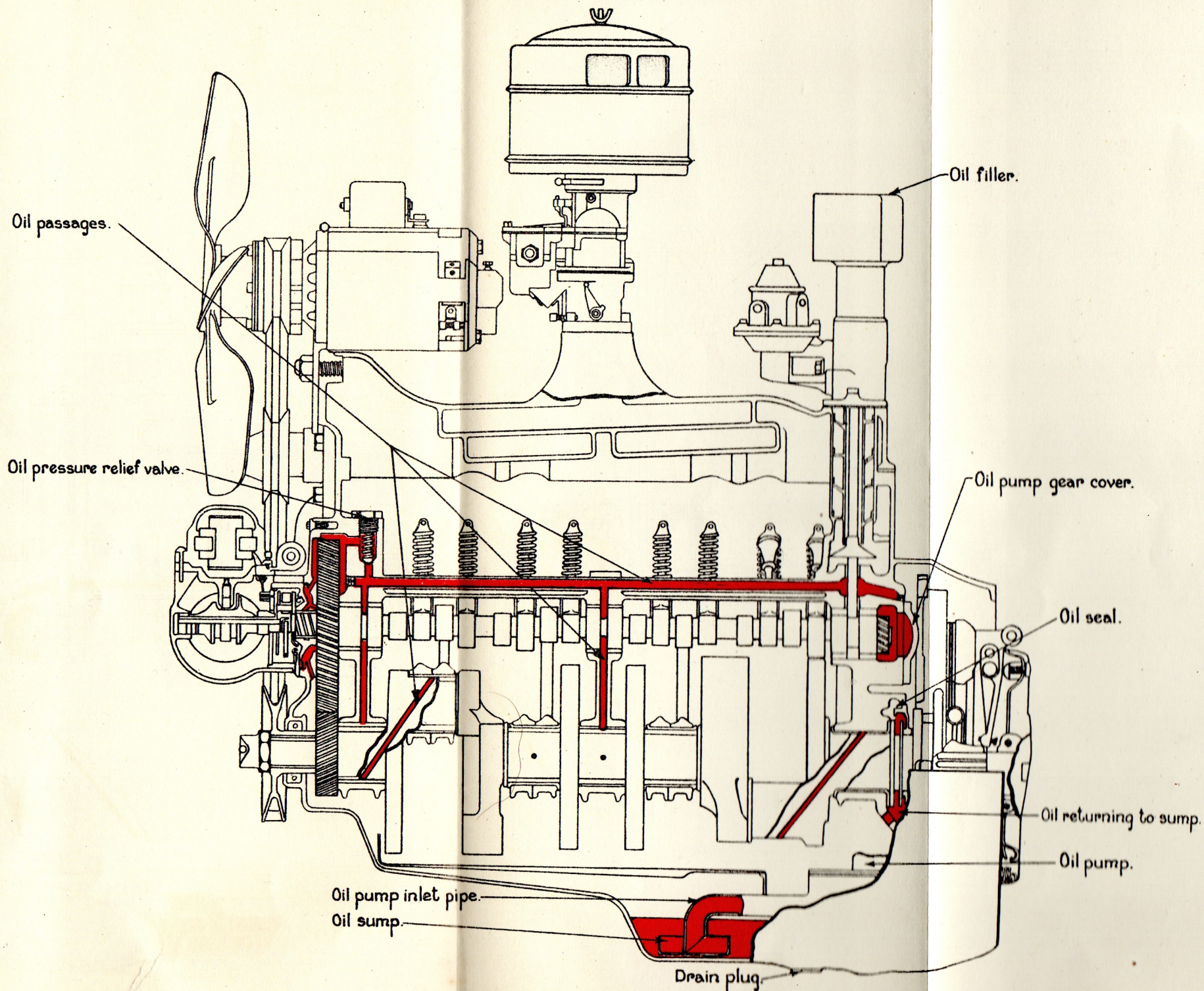
(c) Not for Carriers, Cavalry, Mark. I.

APPENDIX III

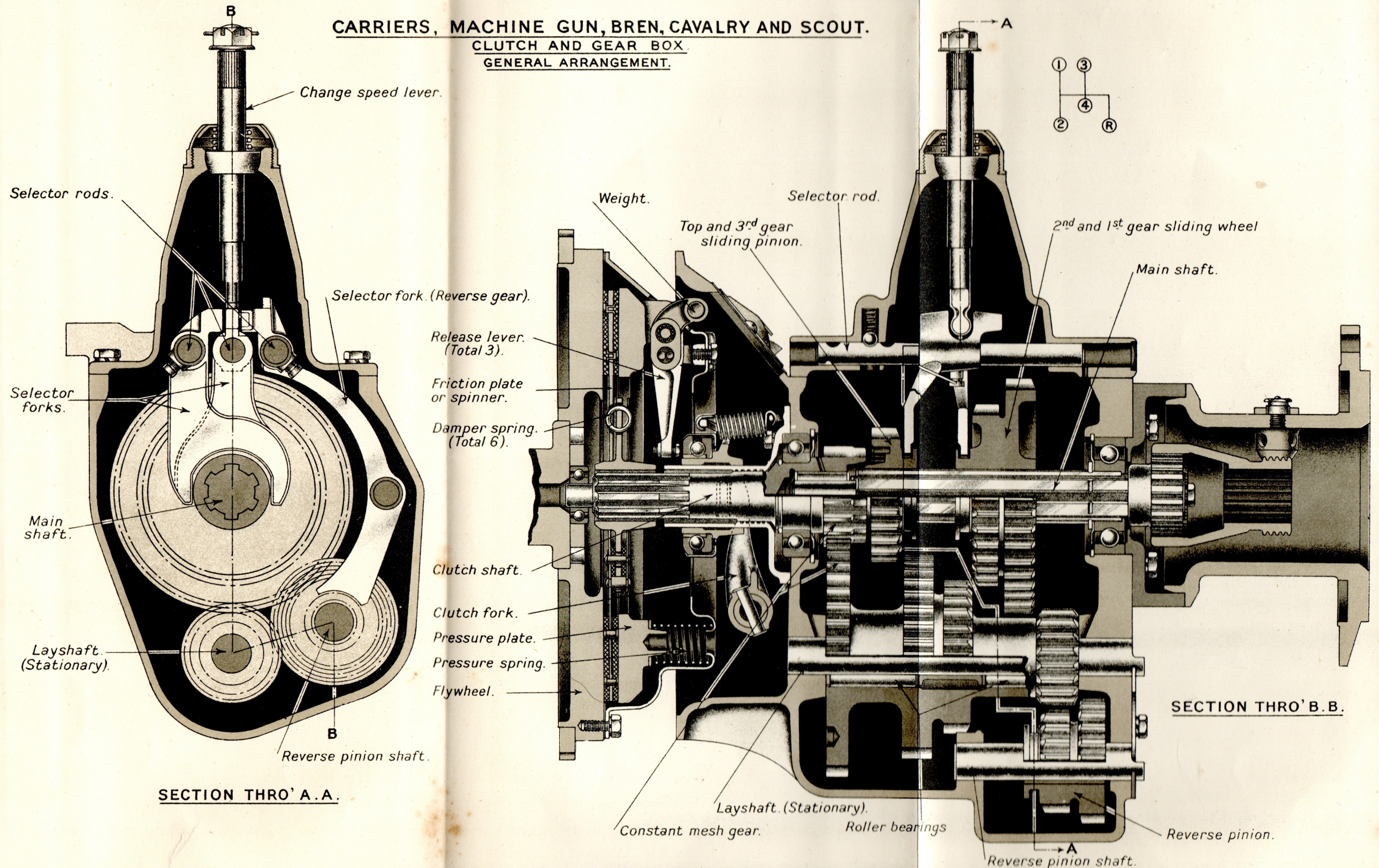
Table of weights and dimensions, etc.

								Carriers														
								M.G., No. 1, Mark I			Bren, No. 2, Mark I			Bren, No. 2, Mark II			Cavalry Mark I			Scout Mark I		
<i>Weights (approximately)</i>								tons	cwt.	qrs.	tons	cwt.	qrs.	tons	cwt.	qrs.	tons	cwt.	qrs.	tons	cwt.	qrs.
Fully laden	..	..	..	..	..	..	..	3	3	3	3	6	0	3	6	0						
Unladen	..	..	..	..	..	..	..	2	17	0	2	19	0	2	19	0						
<i>Dimensions</i>								feet	inches		feet	inches		feet	inches		feet	inches		feet	inches	
Height, maximum	..	..	..	..	..	..	..	4	8		4	9		4	9							
Length, maximum	..	..	..	..	..	..	..	11	6		11	11½		11	11½		11	11½		11	11½	
Width, maximum	..	..	..	..	..	..	..	6	9		6	10¼		6	10¼					6	10¼	
Width, track centres	..	..	..	..	..	..	..	5	2¼		5	2¼		5	2¼		5	2¼		5	2¼	
Width, outer edges of tracks	..	..	..	..	..	..	..	5	11¾		5	11¾		5	11¾		5	11¾		5	11¾	
<i>Miscellaneous</i>																						
Ground clearance, minimum	..	..	..	..	..	..	..	0	7¾		0	7¾		0	7¾		0	7¾		0	7¾	
Fording depth	..	..	..	..	..	..	..								
Width of trench vehicle can cross	..	..	..	..	..	..	..	4	6		4	6		4	6		4	6		4	6	
Space required to turn in	..	..	..	..	..	..	..	8	8		8	8		8	8		8	8		8	8	
Maximum gradient negotiated	..	..	..	..	..	..	..								
Speed	..	..	..	..	..	..	..	25	m.p.h.		25	m.p.h.		25	m.p.h.		25	m.p.h.		25	m.p.h.	
Speed, average on level road	..	..	..	..	..	..	..								
Speed, average across country	..	..	..	..	..	..	..								
Fuel capacity	..	..	..	..	..	..	..	20	gallons		20	gallons		20	gallons		20	gallons		20	gallons	
Fuel consumption	..	..	..	..	..	..	..								
Radius of action	..	..	..	..	..	..	..								

CARRIERS MACHINE GUN, BREN, CAVALRY AND SCOUT **ENGINE LUBRICATION SYSTEM.**

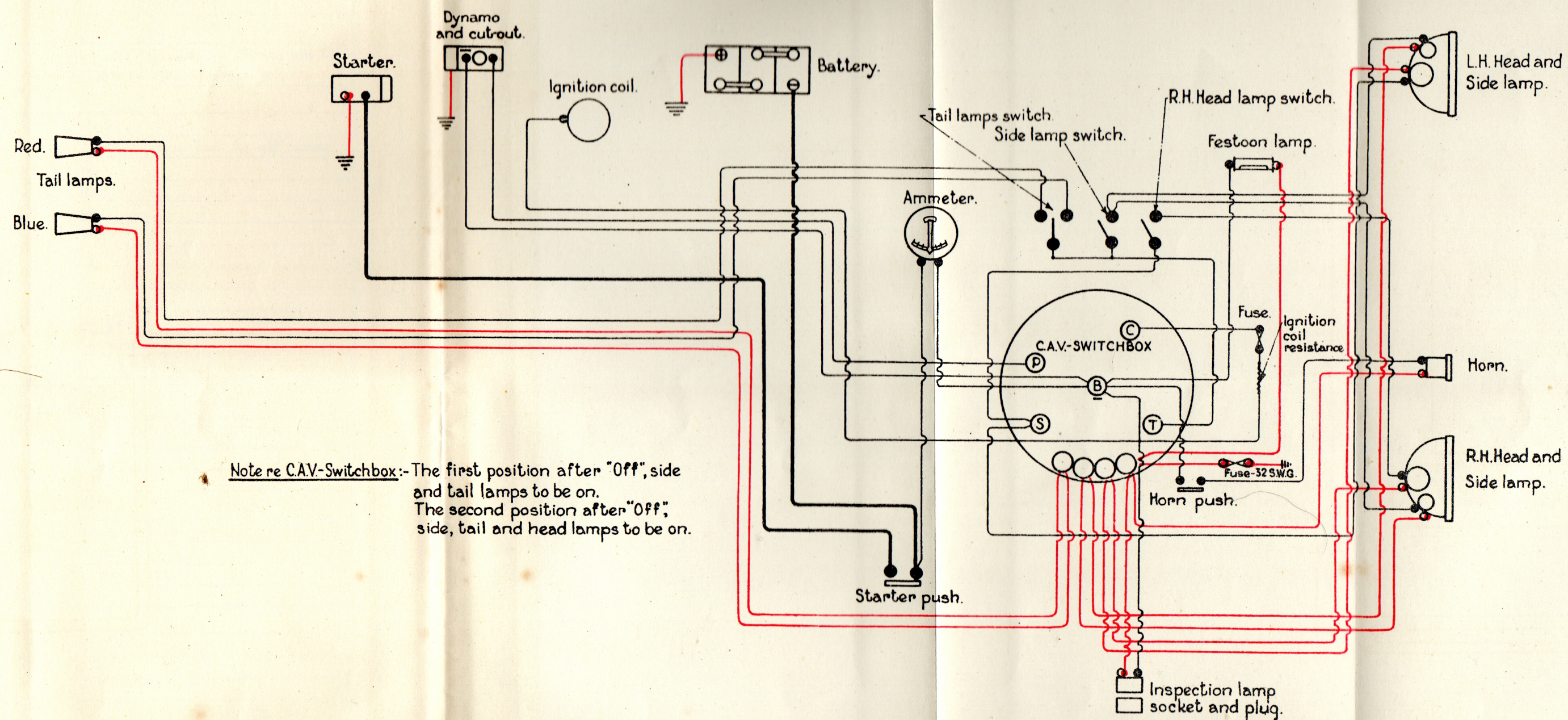


CARRIERS, MACHINE GUN, BREN, CAVALRY AND SCOUT.
CLUTCH AND GEAR BOX.
GENERAL ARRANGEMENT.



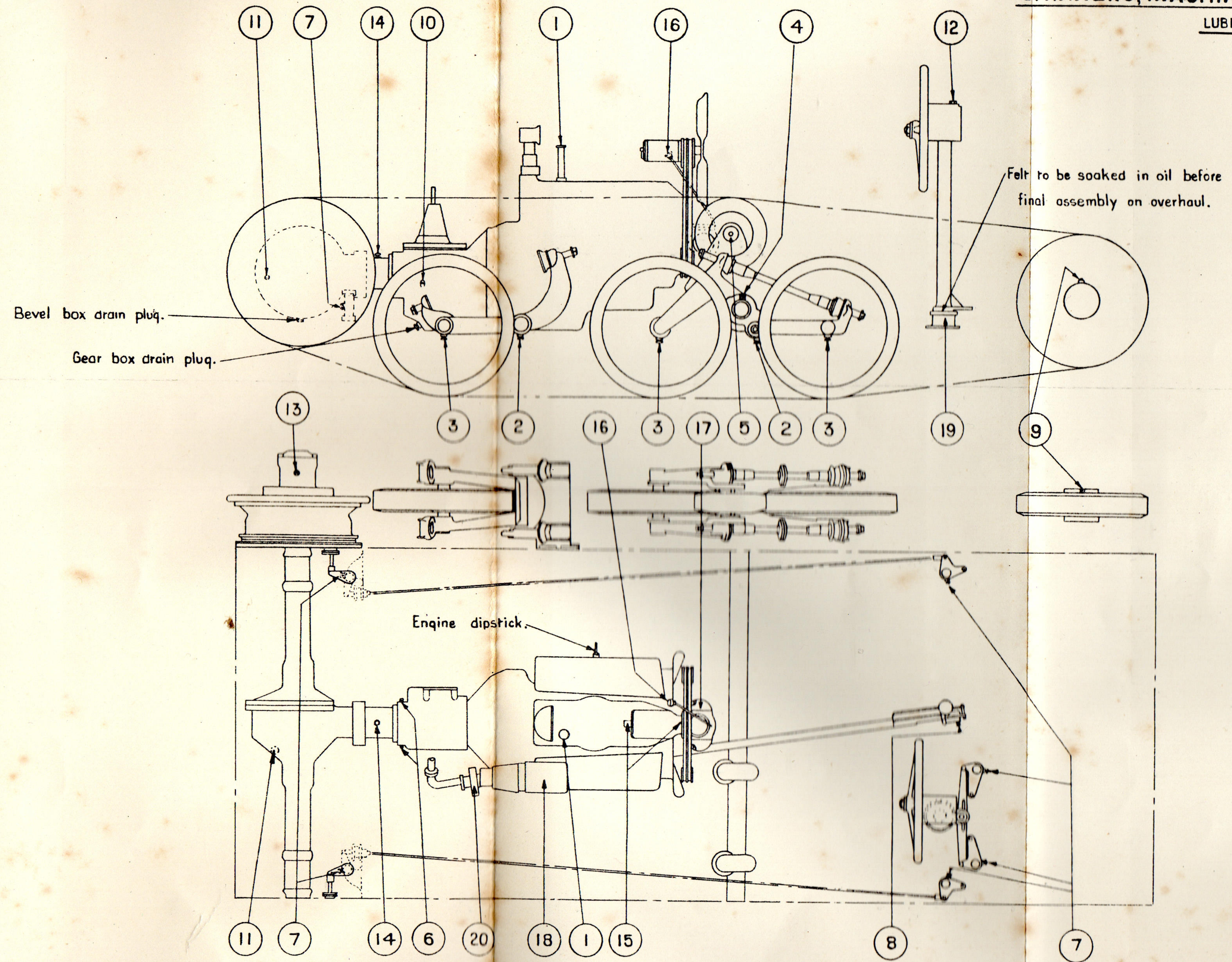
CARRIERS, MACHINE GUN, BREN, CAVALRY AND SCOUT

ELECTRICAL WIRING DIAGRAM.

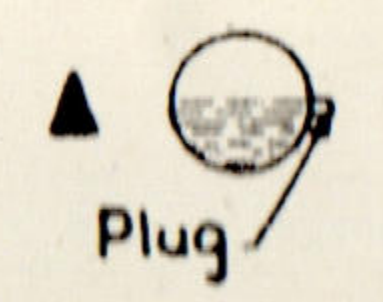


CARRIERS, MACHINE GUN, BREN, CAVALRY AND SCOUT.

LUBRICATION CHART.



See below †

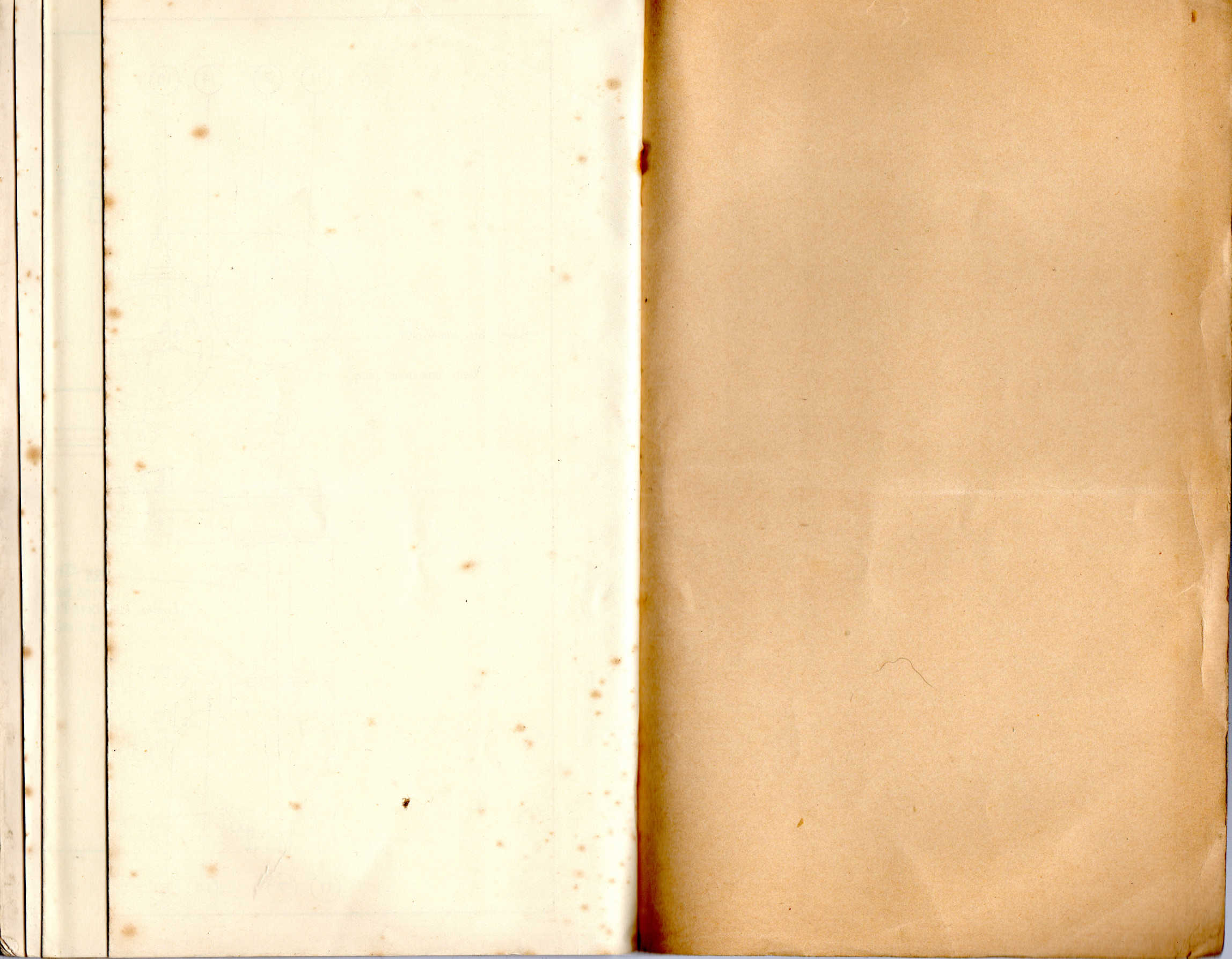


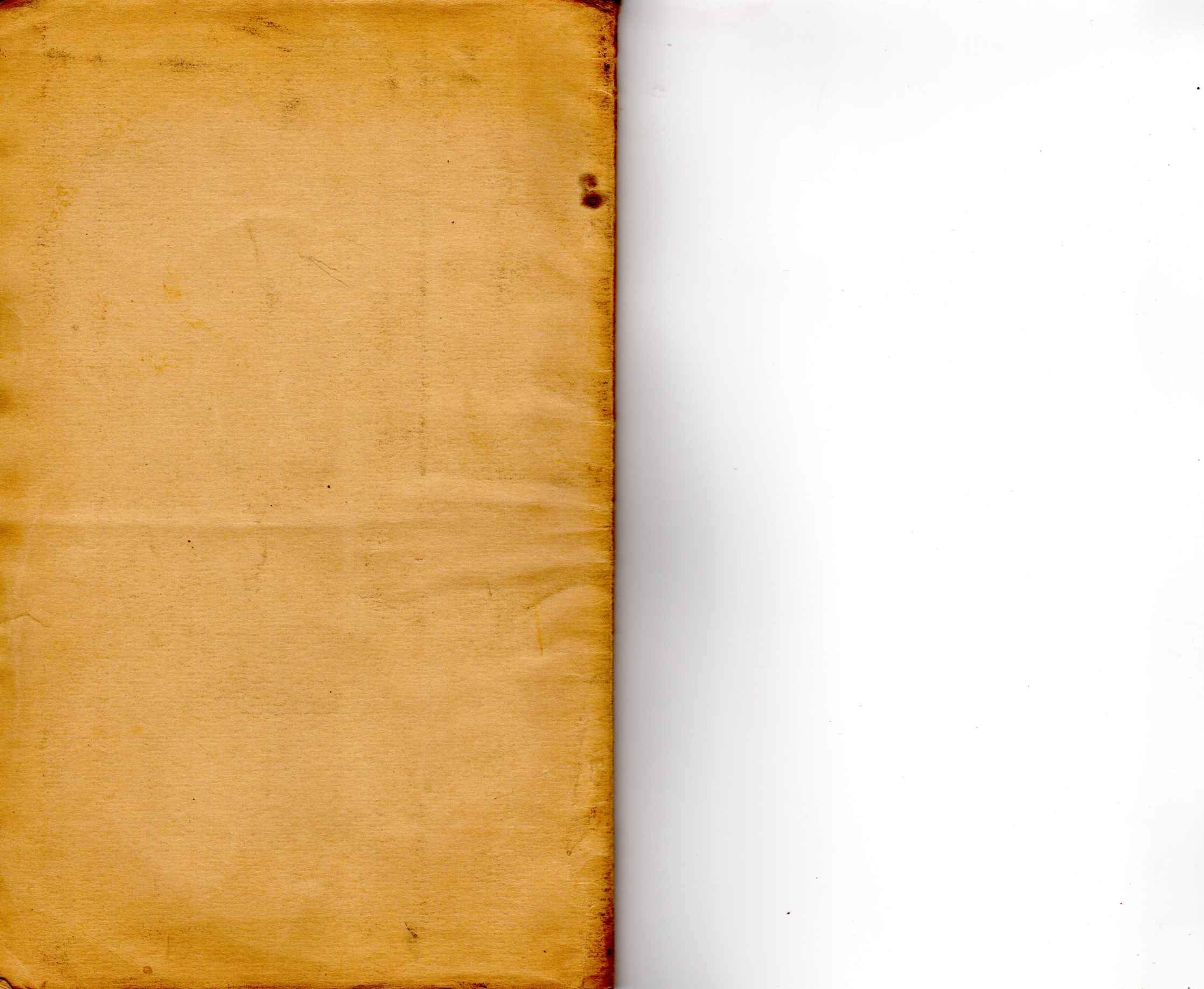
Nº	DESCRIPTION.	LUBRICANT.	REMARKS.
DAILY.			
1.	ENGINE.	M. 220.	Maintain level by dipstick. Change the Oil every 500 Miles. See footnote *.
EVERY 100 MILES (OR WEEKLY).			
	CONTROL JOINTS, CONNECTIONS, ETC.	M. 220.	Oil can.
2.	SECONDARY FORK BEARINGS.	C. 600.	2 Points. Until oil exudes from Air relief valves.
3.	BOGIE WHEEL SPINDLES.	" "	6 Points.
4.	BOGIE BRACKETS (FRONT ONLY).	" "	2 Points.
5.	GUIDE ROLLER SPINDLES.	" "	2 Points.
6.	CLUTCH CROSS SHAFT (ENGINE).	" "	2 Points.
7.	STEERING & TRACK BRAKE CONTROLS.	" "	6 Points.
8.	CHANGE SPEED LEVER.	" "	1 Point.
9.	WHEEL, ADJUSTING, TRACK, BEARINGS.	" "	2 Points.
10.	GEAR BOX.	E. P.	Maintain level.
11.	BEVEL BOX.	E. P.	Maintain level.
EVERY 250 MILES (OR FORTNIGHTLY).			
12.	STEERING BOX.	M. 220.	Check oil and replenish if necessary.
13.	SPROCKET WHEEL BEARINGS.	C. 600	2 Points.
14.	COUPLING, GEAR BOX.	" "	1 Point.
	SPEEDOMETER FLEXIBLE SHAFT.	" "	
EVERY 500 MILES (OR MONTHLY).			
15.	DYNAMO.	M. 220	2-4 Drops in each well.
16.	DISTRIBUTOR.	" "	2-4 Drops.
17.	DISTRIBUTOR CAM.	VASELINE.	Smear cam lightly.
ANNUALLY ON OVERHAUL.			
18.	STARTER MOTOR BEARINGS.	GREASE G.S.	Pack.
19.	STEERING COLUMN BEARING.	" "	Pack.
20.	CHANGE SPEED SHAFT, TRUNNION BEARING.	" "	Pack.

Lubricate on mileage or time basis whichever is due first.

- * First change of engine oil to be made when vehicle has done 250 miles.
- Under no circumstances should engines remain longer than one year without a change of engine oil.

▲ Remove screwed plug, turn axle to position shown, insert oil through terealemit lubricator to level and replace plug.
 † The following are approved lubricants for gear box and bevel box :- Shell "E.P. Spirax heavy" Mobiloil E.P. Vizard "Hy-Ex"
 Castrol "Hi-Press" Trafford "E.P. Filtrate"







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